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SOCIETE BELGE DE MALACOLOGIE

Edgar WAIENGNIER, 1936 - 2010

Membre de la Société Belge de Malacologie depuis 1977, Edgar nous rejoignit au sein du comité en 1980. Depuis lors ses connaissances en matière de malacologie, sa présence régulière à nos réunions, sa participation à nos excursions et son implication dans tous nos projets ont toujours été très précieux et appréciés.

Il était également le spécialiste des mollusques terrestres, en particulier des Helicidae et nous a présenté plusieurs conférences sur ce sujet bien précis.

Nous saluons ici un collègue mais aussi un ami qui sera toujours parmi nous en pensée.

Ce numéro de Novapex est dédié à sa mémoire.

***

Member of the Belgian Malacological Society since 1977, Edgar joined us on the board of directors in 1980. Since then his knowledge of malacology, his regular presence at our meetings, his participation in our field trips and his involvement in all our projects were always highly valued and appreciated.

He was also the specialist on terrestrial molluscs, in particular of Helicidae, and he presented us with several conferences on this subject.

We salute here not only a colleague but also a friend who will always be among us in thought.

This issue of Novapex is dedicated to his memory.

NOVAPEX est paru pour la première fois le 20 février 2000, remplaçant notre revue APEX qui en était à son quatorzième volume. De 2000 à 2010 nous avons publié de nombreux articles dans les numéros ordinaires de Novapex et dans 7 numéros Hors Série. Durant ces 11 années nous avons fait appel à de nombreux référés. Leurs noms sont mentionnés ci-dessous.

NOVAPEX was published for the first time on February 20, 2000 to replace APEX, then at its 14th volume. From 2000 to the end of 2010 we published numerous papers in the normal issues of Novapex and in 7 Special Issues. During these 11 years we asked for the help of many referees. They are listed below.

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Cypraeidae (Mollusca: Gastropoda) from the early Miocene Cantaure Formation of northern Venezuela

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KEYWORDS. Cypraeidae, Mollusca, Miocene, Cantaure Formation, Venezuela, new species.

ABSTRACT. This is the first account of the rich assemblage of Cypraeidae from the late early Miocene, Burdigalian Cantaure Formation, Paraguaná Peninsula, Falcón Province, Venezuela. Twelve species are recorded from these deposits, ten of which are new to science; *Luria cantaurana* n. sp., *L. isabellaprimitiva* n. sp., *Trona ingrami* n. sp., *Propustularia longidentata* n. sp., *P. paraguanensis* n. sp., *Zonaria pingata* n. sp., *Z. pseudotumulus* n. sp., *Pseudozonaria praeaequinoctialis* n. sp., *P. primarobertsi* n. sp. and *P. falconensis* n. sp. Comparative taxon *Muracypraea "henekeni"* of Groves (1997) from the middle to late Miocene Gatun Formation of Panama and Angostura Formation of Ecuador is herein described as *M. woodringi* n. sp. *Cypraea fossula* (Ingram, 1947) is considered a junior subjective synonym of *Trona trinitatensis* (Mansfield, 1925). The type material of *Jousseaumea joossi* Schilder, 1939 and *Pustularia mejasensis* Schilder, 1939 are in very poor condition and do not adequately show species characteristics, and are therefore considered *nomina dubia*.

INTRODUCTION

A rich and varied cypraeid fauna is here reported from the early Miocene (Burdigalian) Cantaure Formation as defined by Hunter and Bartok (1974), Paraguaná Peninsula, Falcón State, Venezuela. Schilder (1939) first documented the family Cypraeidae from these deposits with the report of *Luria (Basilitrona) patrespatriae* (Maury, 1917) and Ingram (1947) described *Cypraea fossula* from the same formation. However, no further cypraeid taxonomic work on the Cantaure Formation has been attempted. Jung's (1965) landmark systematic monograph on the assemblage described and illustrated a specimen identified as *Cypraea* aff. *isabella* Linnaeus, but made no further mention of additional cypraeids in the formation. Herein, these omissions are addressed.

Gibson-Smith & Gibson-Smith (1979) described the presence of 'upper' and 'lower' beds in the Cantaure Formation. The basal unit is defined by a breccia composed of *Balanus* barnacle fragments and blocks of granite overlain by silty and gypsiferous shales with sandy levels (Hunter & Bartok, 1974). They also note rich molluscan levels within the lower unit. The upper level is sandier, and the transition between the two units is unclear. Dr. Emily Vokes, who has also visited the deposits, did not recognize the presence of an 'upper' and 'lower' bed (personal communication, BL). The gastropod assemblage found in the 'upper' and 'lower' beds is similar, with a predominance of filter-feeding turritellids in the 'upper' beds and a greater number of rocky-bottom dwellers in the 'lower' bed. Cypraeids are not common in the Cantaure Formation, but are found far more often in the 'lower' beds, which are designated as the type locality for the new species.

Material and Methods

The material described here is from the Gibson-Smith collection housed in the Naturhistorisches Museum Basel (NMB coll.), Switzerland and the Bernard Landau collection (BL coll.), now deposited in the Naturhistorisches Museum Wien (NHMW coll.), Vienna, Austria. Some specimens are deposited in the Natural History Museum of Los Angeles County, Invertebrate Palaeontology Department (LACMIP coll.). All shells were also examined under UV light as described by Olsson & Petit (1968).

Abbreviations

Abbreviations used for institutional catalogue and/or locality numbers are as follows: ANSP, Academy of Natural Sciences of Philadelphia, USA; BL, Collection of Bernard Landau (Collection now at

NHMW); DFB coll., Dirk Fehse collection, Berlin, Germany: LACMIP Natural History Museum of Los Angeles County, Invertebrate Palaeontology Department, Los Angeles, California, USA; NHMW, Naturhistorisches Museum Wien, Vienna, Austria; NMB, Naturhistorisches Museum Basel, Switzerland; PPP, Panama Palaeontological Project; TU, Tulane University, New Orleans, USA (Tertiary collections now at the National Museum of Natural History, Smithsonian Institution [USNM]); UCMP, University of California, Museum of Paleontology, Berkeley, California, USA; and USGS, United States Geological Survey, Reston, Virginia, USA.

Systematic Palaeontology

Cypraeids can be a notoriously difficult group to work on, especially the fossils as the surface colour and pattern are usually lost. A single major taxonomic study has been undertaken in recent years on the tropical American Neogene cypraeid assemblages; Dolin (1991) revised the Cypraeoidea from the late early Miocene Chipola Formation of northern Florida, which is roughly contemporaneous with the Cantaure Formation. For the ease of comparison of the two faunas, the morphologic terminology of Dolin (1991: fig. 1) and Dolin & Lozouet (2004: figs. 2a-c) are utilized.

Cypraeid systematics has been greatly enhanced by the works of Meyer (2003, 2004) in particular his molecular data-base for the family. The phylogenetic implications of this new data outlined by Meyer (2004), and the systematic arrangement suggested by López Soriano (2006) based on Meyer's work, are followed here. Higher level systematics follows that of Bouchet, et al. (2005).

The shell formula proposed by Schilder (1935: 327) has been given for each species. This formula is derived from measurements taken from all available fully mature and normally formed specimens. It consists of the following elements: [L (W-H) LT: CT]. L: average length in mm, W: average width/ length ratio in %, H: average height/ length ratio in %, LT: normalized number of labral teeth, CT: normalized number of columellar teeth. The normalized number of teeth – in relation to a shell of 25 mm length – is calculated as follows: $T = 7 + [(c-7) \times \sqrt{(25/L)}]$, T: normalized number of teeth, c: teeth counted, L: length. This shell formula is useful to highlight differences and similarities between species, but should not be used on its own to distinguish between species.

Class **GASTROPODA** Cuvier, 1791
Clade **HYPSOGASTROPODA** Ponder & Lindberg, 1997
Clade **CAENOGASTROPODA** Cox, 1959
Clade **LITTORINIMORPHA** Golikov & Starobogatov, 1975
Superfamily **CYPRAEOIDEA** Rafinesque, 1815
Family **CYPRAEIDAE** Rafinesque, 1815
Subfamily **CYPRAEINAE** Rafinesque, 1815
Genus ***Muracypraea*** Woodring, 1957
Type species: *Cypraea mus* LINNAEUS, 1758, by original designation.

Description. Shell pyriform to triangular of small to moderately large size (30 to 75 mm); posterior part of dorsal surface smooth, roughened, warty, or bituberculate; outer lip, wide, slightly constricted near anterior end; fossula indistinct, wide, shallow, and smooth.

Discussion. A consensus among specialists on the generic assignment for this group of species is lacking as is an agreement of the number of living and fossil species (Woodring, 1959; Petuch, 1979, 1987; Doneddu & Manunza 1996; Lorenz & Hubert, 2000; Meyer, 2004). This may in part be due to the inadequate description of the type species by Woodring (1957). *Muracypraea* was originally proposed as a subgenus of *Cypraea*. Lorenz & Hubert (2000) considered "*Muracypraea*" an informal group within *Siphocypraea* Heilprin, 1887 which was proposed as a subgenus within the genus *Cypraea*. Some species of the *S. problematica* complex have a strongly curled comma-shaped posterior channel that conceals the spire. *Muracypraea* was proposed for the Recent *Cypraea mus* Linnaeus, 1758 and the related fossil species that possess a more normal posterior, wide aperture, and commonly well-developed dorsal callosities, dorsal tubercules, and occasionally a central spike-like dorsal projection. *Siphocypraea* ranges from the early Pliocene to Pleistocene and is restricted to the southeastern United States whereas *Muracypraea* ranges from the early Miocene to Recent of the Caribbean Basin to Peru and southeastern California. Doneddu & Manunza (1996) and Fehse (in press, a) considered *Muracypraea* a junior synonym of *Barycypraea* Schilder, 1927. They drew attention to the long geologic history of the genus with fossil representatives in the Indo-Pacific (see Dharma, 2005; Fehse (in press, b) and the Caribbean Tertiary. Doneddu & Manunza (1996) traced the origins of the *M. mus* complex to *Cypraea (Bernayia)* [*sic*] *saltoensis* (Clark *in* Clark & Durham, 1946) of the Eocene of Colombia. However, close examination of the poorly preserved holotype makes it clear that a conclusive generic assignment is not possible, and determination of a possible new genus is beyond the scope of this paper. Kay (1996) and Groves (1997) used *Muracypraea* as a full genus. Woodring (1959) considered all Miocene specimens from the circum Caribbean basin to be *Cypraea (Muracypraea) henekeni* (lectotype; Figs 144-145). However, it is notable that specimens from the Miocene Gatun Formation of Panama are different from those of Venezuela, Trinidad, Colombia, and the Dominican Republic. Most specimens from the Gatun Formation examined by the senior author have an

axially striped colour pattern or blotching of dull reddish brown or yellowish orange. Additionally, the marginal callus is extremely thin and poorly delimited, and does not extend onto the dorsum, and the shell periphery of the Gatun shells feel corrugated, whereas they are smooth in *M. henekeni* and *M. hyaena*. We separate two distinct taxa within the Gatun assemblages (see below). The early Pliocene *Muracypraea grahami* (Ingram, 1947) from Cubagua, Venezuela (Figs 29-32) is again different (Landau & Silva, 2010). Ingram (1947) described two *Muracypraea* species from Cubagua; *Cypraea rugosa* [junior homonym of *C. rugosa* Broderip, 1827] and *Cypraea grahami*. Although the holotypes of the two shells look quite different, Landau & Silva (2010) illustrated intermediate forms and recognised a single species in the Cubagua deposits. The shell is very large and solid (63-73 mm in length) and their outline is more triangular and their dorsum even higher than *M. hyaena* (Landau & Silva 2010). The tubercles are staggered on the dorsum in a similar fashion to *M. hyaena*. The margins are corrugated, as in *Muracypraea isthmica* Schilder, 1927, but more coarsely so. In the best preserved specimen from Cubagua an indication of a striped colour pattern is present, akin to that seen in the Gatun Formation shells. On the Pacific side of the Gatunian Province *Muracypraea cayapa* (Pilsbry & Olsson, 1941) from the early Pliocene Jama Formation of Ecuador is a large poorly known species represented by a single broken specimen. Many other taxa of *Muracypraea* have been described from the Caribbean Neogene, which await validation. Species of the extant *Muracypraea mus* complex are known to have an intracapsular larval development (Ranson, 1967; Hoeblich, 1979). This assumption cannot be validated with the fossil taxa, however, this type of development would favour a restricted distribution of species and a high degree of variability between populations. This helps explain the difficulty encountered with the Caribbean Neogene *Muracypraea* populations and may be analogous to the situation among Recent species of the genus *Zoila* Jousseaume, 1884 in Australia which also shows intracapsular development. Numerous species of *Zoila* are not only geographically restricted, but numerous intermediate forms are common off the western and southern coasts of Australia (Lorenz, & Hubert, 2000; Lorenz, 2001).

Based on mitochondrial molecular data presented by Meyer (2004), the two extant *Barycypraea* taxa *B. tenlerei* (Cazenavette, 1846) and *B. fultoni* (Sowerby, 1903) were placed as sister taxa to *Zoila* Jousseaume, 1884, reaffirming the (validity of the subfamilial clade Bernayinae Schilder, 1927, whereas *Muracypraea mus* was placed in the Cypraeinae Gray, 1824. Based on morphological differences, Fehse (in press, a) will reassign the two living *Barycypraea* species and the fossil species *B. zietsmani* (Liltved & LeRoux, 1988) [Pliocene, South Africa], *B. schilderi* (Dey in Schilder, 1941) [Pliocene, India], *B. gendingaensis* (Martin, 1899) [Pliocene, Indonesia], and *B. kendengensis* (Schilder, 1941) [Pliocene, Indonesia] to a new genus (Dirk Fehse personal communication 2010). Some of the shells of the Indonesian fossil *Barycypraea* group are extremely similar to those of *Muracypraea* in the Tropical American Neogene and could represent a convergent evolutionary process. A morphological feature that helps separate *Muracypraea* from *Barycypraea* are the flattened spatulate horizontal expansions on either side produced from the abapical tips of the inner and outer lips of *M. henekeni* and many related species. Occasionally these spatulate expansions are hyper developed in the Caribbean forms whereas they are somewhat obsolete in the Indonesian species of *Barycypraea*. Although the two genera may have a common Tethyan ancestor, consistent shell differences and the vast geographic separation could justify different genera. Many of the *Muracypraea* shells are lightweight, less callused with a broad aperture and less developed, widely spaced dentition, whereas the shells of *Barycapraea* are heavy, strongly callused with a narrow aperture and a distinct, close-set dentition. The *Muracypraea* exceptions being *M. mus donmorei* (Petuch, 1979), *M. mus bicornis* (Sowerby, 1870), and *M. grahami* (*C. rugosa* Ingram, 1947 junior homonym of *C. rugosa* Broderip, 1827; see Landau & Silva 2010). The dorsal callosities of both genera can be variable even among the same species. However, in *Muracypraea* they tend to be restricted to the posterior portion of the dorsal surface whereas in *Barycypraea* there may be a second set located slightly anterior of the dorsum centre. Because the Miocene fossil record for the central Pacific islands is incomplete, and until a conclusive answer to whether two genera should be used for the two seemingly geographically separated species-groups, the classification of Schilder & Schilder (1971) for *Muracypraea* is used for the Caribbean species.

Muracypraea hyaena (Schilder, 1939)
Figs 1-14

1939 *Siphocypraea angustirima hyaena* Schilder, p. 23, fig. 24.
1971 *Siphocypraea (Muracypraea) angustirima hyaena* Schilder and Schilder, p. 29.

Material. 8 specimens BL coll.; 1 specimen LACMIP 13648 (ex BL coll.).

Description. Shell small to medium, solid, rotund, dorsum very strongly humped ⅔ distance from the anterior end, in fully adult specimens bearing two small tubercles, right tubercle larger and anterior to left; spire depressed, covered by adapical callus; sides rounded, strongly callused, with the callus ascending progressively adapically to just below the apex posterior to the dorsal hump; ventrum flattened, slightly convex in profile; aperture almost straight,

anterior third weakly dilated; siphonal canal deep, abaxially asymmetrical and abapically orthogonally truncated, flanked on either side by flattened spatulate horizontal expansions produced from the abapical tips of the inner and outer lips; exhalant channel deeper, limited by parallel lips; about 4 mm width weakly concave channel between terminal ridge and first columellar tooth, followed by 13-14 stout, short columellar teeth, extending a short distance onto the ventrum and into the aperture; terminal ridge obsolete, merged into smooth abapical edge of fossula; fossula small, concave, smooth; labral teeth heavy, 14-16 in number, evenly distributed. Ventral and dorsal zones spotted, marginal callus lighter coloured with larger ocellated spots.

Shell formula. 39.4 (76.9 – 58.2) 16: 15

specimen	collection number	length	width	height	LT	CT
BL coll. 1; (Figs 5-6)		47.2	36.9	26.9	14	14
BL coll. 2; (Figs 1-4)		49.7	37.1	29.8	14	14
BL coll. 3; (Figs 7-8)		44.6	34	25.2	15	14
BL coll. 4		42.9	33.3	25.2	14	13
BL coll. 5		37.8	30	21.5	14	#
BL coll. 6		37.1	29.1	20.4	16	14
BL coll. 7		32.7	24.7	20.5	#	#
BL coll. 8		32	24.5	19.1	13	11
(Figs 9-12)	LACMIP 13648	30.4	23.3	17.7	16	13

Table 1. Dimensions and number of teeth; *Muracypraea hyaena* (Schilder, 1939).

Discussion. *Muracypraea hyaena* (Schilder, 1939) (holotype; Figs 13-14) was described from younger late Miocene beds in the Urumaco area, Falcón Dept., Venezuela (Sánchez-Villagra & Aguilera, 2006). The holotype is in very poor condition, but the general shape, strength of the dorsal hump, disposition of the teeth, and colour markings are consistent. There is some variability as to the presence or absence of tubercles on the dorsal hump; the tubercles usually present only in fully grown specimens, although our largest specimen (Figs 1-4) is devoid of tubercles and the smallest (Figs 9-12) has well developed little tubercles.

Perilliat (1992) figured a fairly well preserved specimen identified as *Siphocypraea (Muracypaea)* sp. cf. *S. (M.) angustirima hyaena* Schilder from the middle Miocene Ferrotepec Formation, Michoacán, southern Mexico. This specimen is indeed a *Muracypraea* somewhat similar to *M. hyaena* but has coarser dentition and has a more produced anterior. The Ferrotepec Formation shell is more likely an undescribed species.

Geological and geographical distribution.

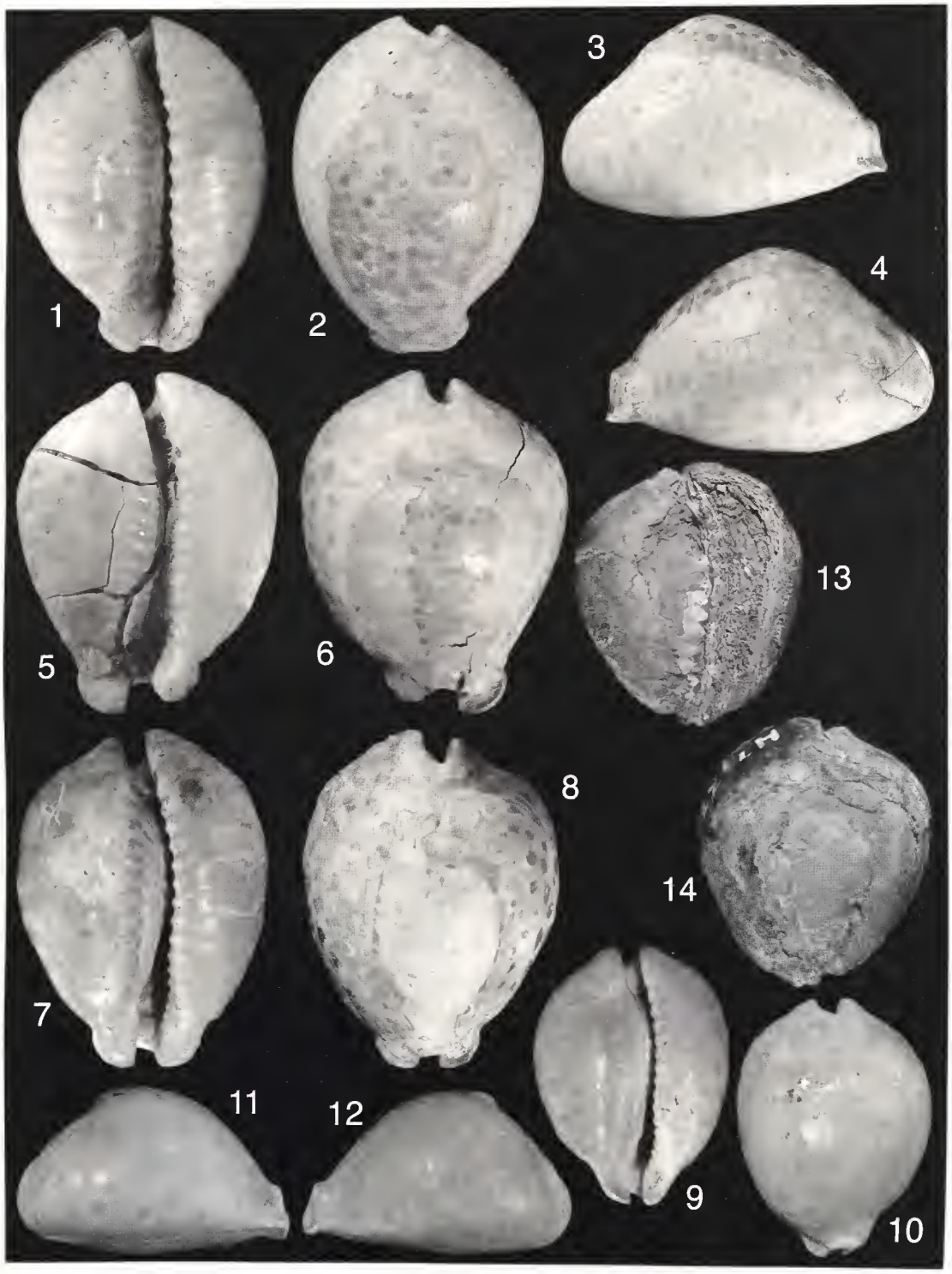
Lower Miocene: Cantaure Formation, Venezuela.
Middle Miocene: Urumaco, Venezuela (Schilder, 1939).

***Muracypraea woodringi* n. sp.**
Figs 21-28

1951 *Cypraea* cf. *C. henekeni* Sowerby – Marks, p. 376.
1959 *Cypraea (Muracypraea) henekeni* Sowerby – Woodring, p. 194, pl. 32, figs 1, 4, 6, 9.
1964 *Siphocypraea (Muracypraea) henekeni* (Sowerby) – Olsson, p. 176, pl. 31, figs 3-3a.
1993 *Cypraea (Muracypraea) henekeni* Sowerby – Pit & Pit, p. 3, pl. 1, fig. 7.
1997 *Muracypraea "henekeni"* (Sowerby, 1850) – Groves, p. 152, pl. 1, figs 4-6.

Figures 1-14

1-4. *Muracypraea hyaena* (Schilder, 1939) NHMW 2010/0036/0024 (NMMW; ex BL coll. no. 2), length 47.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **5-6.** *Muracypraea hyaena* (Schilder, 1939) NHMW 2010/0036/0025 (NMMW; ex. BL coll. no. 1), length 47.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **7-8.** *Muracypraea hyaena* (Schilder, 1939) NHMW 2010/0036/0026 (NMMW; ex. BL coll.no. 3), length 44.6 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **9-12.** *Muracypraea hyaena* (Schilder, 1939) LACMIP 13648 (LACMIP coll.; ex BL coll.), length 30.4 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela. **13-14.** *Muracypraea hyaena* (Schilder, 1939) Holotype NMB H11272 (NMB coll.), length 31.0 mm. Urumaco area, Falcón Dept., Venezuela, Urumaco Formation, early late Miocene.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Dimensions and type material. Holotype; LACMIP 12431, length 42.1 mm (Figs 23-24); paratype 1 ANSP 315087, length, 42.0 mm (Figs 21-22); paratype 2 USNM 562582, length, 38.5 mm, paratype 3 NHMW 2010/0036/0001 (ex. BL coll.) length 43.4 mm (figs. 25-28).

Other Material. Panama, three incomplete specimens PPP 02168 (NMB 18667); three incomplete specimens PPP 02119 (NMB 17637); two specimens PPP 00490 (NMB 17871); four specimens PPP 00487 (NMB 17868); one specimen PPP 1080 (NMB 18261); one specimen PPP 00224 (NMB 17642); two specimens PPP 01034 (NMB 18258); one incomplete specimen PPP 01078 (NMB 18325) all NMB coll.; one specimen locality ANSP 1731 (internal mould); one specimen locality LACMIP 16936; five specimens locality LACMIP 17908 (= TU 757); five specimens locality LACMIP 17909 (= TU 958); two specimens locality LACMIP 17910 (= TU 960); two specimens locality LACMIP 17911 (= TU 1432); one specimen from LACMIP 17912 (= TU 1433); Cativa, Colón, BL coll. (All Gatun Formation); Colombia, one specimen locality UCMP 154008 (fragment), Nariño Dept.; Ecuador, one incomplete specimen PPP 03391 (NMB 19122); one specimen AGC 99-102, NMB coll.; Baja California Sur, Mexico, one specimen locality USNM 1/1238 (*ex* USGS), San Ignacio Formation(?).

Type locality. Angostura Formation (late Miocene), Loc. LACMIP 16943 [= TU 1507], just east of Río Verde, approximately 30 km east of Río Esmeraldas Esmeraldas Province, Ecuador.

Type stratum. Angostura Formation (late Miocene).

Description. Shell medium-sized for genus, solid, triangular-shaped, dorsum very strongly humped ⅔ distance from the anterior end, bearing two groups of small warty tubercles, left group larger and slightly anterior to right; spike-like projection at centre of apex rises 2 mm above dorsal surface; spire depressed, covered by adapical callus; sides rounded, strongly callused, with the callus ascending progressively adapically to just below the apex posterior to the dorsal hump, callus edge poorly delimited; ventrum flattened, slightly convex in profile; aperture almost straight, anterior third weakly dilated; anterior canal deep, abaxially asymmetrical and abapically orthogonally truncated, flanked on either side by flattened spatulate horizontal expansions produced from the abapical tips of the inner and outer lips; posterior channel deeper, limited by parallel lips; about 4 mm width weakly concave channel between terminal ridge and first columellar tooth, followed by 14 stout, becoming weak posteriorly, short columellar teeth, extending a short distance onto the ventrum and into the aperture; terminal ridge obsolete, merged into smooth abapical edge of fossula; fossula small, concave, smooth; labral teeth heavy, 14 in number, evenly distributed, becoming weak posteriorly. Ventral and dorsal zones striped, marginal callus lighter coloured, dorsum with irregular stripes of dull red-orange and tan.

Shell Formula. 45.3 (80.0 – 60.0) 21: 14

specimen	collection number	length	width	Height	LT	CT
holotype (Figs 23-24)	LACMIP 12431	43.5	34.5	27.1	18	#
paratype 1 (Figs 21-22)	ANSP 315087	42.1	34.1	24.6	14	13
paratype 2	USNM 562582	46.0	36.9	24.3	#	#
paratype 3 (Figs 25-28)	NHMW 2010/0036/0001	43.4	31.1	25.6	18	13
	CAS 66589.06	37.5	29.7	22.6	#	#
	USNM 562581	52.7	44.0	31.8	#	#
BL coll. 1		38.4	31.6	21.4	18	13
BL coll. 2		42.4	35.1	23.1	17	12
BL coll. 3		57.6	45.1	31.8	18	12
BL coll. 4		48.8	41.0	28.5	17	13
BL coll. 5		46.6	35.5	26.7	17	12
DFB coll.	No. 7406-1	48.5	39.8	26.3	17	11
DFB coll.	No. 7406-2	38.8	32.7	22.1	16	12

Table 2. Dimensions and number of teeth; *Muracypraea woodringi* n. sp.

Discussion. *Muracypraea woodringi* is described for the forms noted by Groves (1997) as *M. "henekeni"* from the Gatun Formation of Panama, the Angostura Formation of Ecuador, and Miocene strata in southwestern Colombia. A poorly preserved specimen from southern Baja California Sur, Mexico may also represent *M. woodringi*. *Muracypraea woodringi* is most similar to *M. isthmica* (Schilder,1927) [= *Cypraea henekeni* Sowb. var. of Brown & Pilsbry (1911:356-357, pl. 26, figs. 9-10)] also from the Gatun Formation, which has a broad, smooth rounded, poorly delimited dorsal gibbosity centrally positioned (Figs 23-24). These shells were illustrated by Woodring (1959: pl. 31, figs 6-10). The specimen illustrated by Brown & Pilsbry (1911: pl. 26, figs. 9-10) clearly has a single dorsal gibbosity. Unfortunately, the holotype is missing. Brown & Pilsbry (1911: 356) noted that the "aperture is like that

of Santo Domingo *C. henikeni* [sic], except that the teeth are more compressed and longer. In a specimen 42.5 mm. long there are 15 teeth on the inner, 19 on the outer lip." The length of the denticles seems variable, but on average *M. isthmica* has fewer denticles on both the inner and outer lips than *M. henekeni* or *M. hyaena*. Woodring (1959: pl. 32, figs. 1, 4, 6, 9) illustrated specimens that are considered true *M. woodringi*. The two Gatun Formation taxa cannot be separated by their dentition or fossula. Landau and Silva (2010) discussed the presence of the genus in the Venezuelan Pliocene assemblages and stressed the need for a full revision of the genus. This much needed revision is again outside the scope of this work, however, at least half a dozen different *Muracypraea* species may occur in the tropical American Neogene.

Etymology. Named for Wendell P. Woodring in recognition of his monumental work on the geology and palaeontology of the Panama Canal Zone region.

Geological and geographical distribution.

Upper Miocene: Angostura Formation, Ecuador; Gatun Formation, Panama.
Miocene (indeterminate): Nariño Dept., Colombia.

Subfamily **LURIINAE** Schilder, 1932
Genus ***Luria*** Jousseaume, 1884
Type species: *Cypraea lurida* Linnaeus, 1758, by original designation.

Discussion. Dolin (1991) synonymised the genera/subgenera *Tessellata* Jousseaume, 1884 (type species *Cypraea tessellata* Swainson, 1822), *Basilitrona* Iredale, 1930 (type species *Cypraea isabella* Linnaeus, 1758) and *Fossacypraea* Schilder, 1939 (type species *Cypraea hieroglyphica* Schilder, 1923) with *Talparia* Troschel, 1863. Lorenz & Hubert (2000) considered "*Basilitrona*" and "*Tessellata*" as species groups within the genus *Luria* Jousseaume, 1884. Dolin & Lozouet (2004) transferred the tropical American species included in *Talparia* by Dolin (1991) to *Luria (Tessellata)*. Meyer's (2004) molecular data supports the systematic arrangement of Lorenz & Hubert (2000), on the basis of which López Soriano (2006) formally synonymised *Tessellata* with *Luria*. Shells in the genus *Luria* differ from those in *Talparia* in having blunt extremities, short and deep anterior and posterior canals, the anterior canal is straight as opposed to slightly off-set in *Talparia*, and the angulation is more prominent with the labral teeth developed at the angulation running into the aperture but not onto the ventrum. In *Talparia* the angulation is developed and raised in the anterior portion but not in the mid and posterior portion with the teeth extending a short distance onto the ventrum. The character of the fossula; spoon-like, smooth or weakly ribbed, with denticles on the inner margin, is similar in both genera.

***Luria cantaurana* n. sp.**
Text-figure 1; Figs. 37-44

Dimensions and type material. Holotype; NHMW 2010/0036/0002, lenght 56.0 mm (Figs 37-40); paratype 1 NHMW 2010/0036/0003, length, 42.0 mm (Figs 41-44); paratype 2 NHMW 2010/0036/0004, length, 38.5 mm.

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

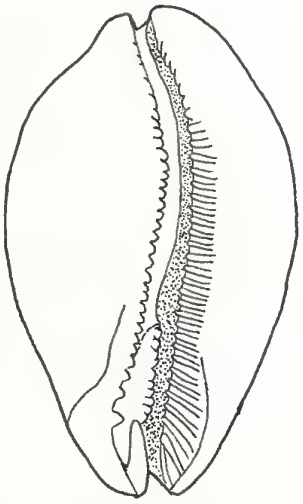
Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell medium-sized for genus, solid, subcylindrical, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire involute, covered by adapical callus; sides rounded, callused, the callus extending to between ⅔ and ¾ height; ventrum flattened, especially in the anterior portion, slightly convex in profile in the posterior portion; aperture parasigmoidal, anterior third wider, dilated by hemispherical expansion on the labrum; siphonal canal deep, abaxially asymmetrical and abapically orthogonally truncated; exhalant channel deep, limited by parallel lips; 28-33 very short columellar teeth most clearly developed at the angulation, running a short distance into the aperture, but not onto the ventrum; angulation sharp and ridge-like in the anterior and mid-portions; terminal ridge weakly developed, merged into abapical edge; fossula well-delimited, spoon-like, concave, broad, smooth, fringed with weak denticles at its inner edge; columella peristome smooth; 24-29 labral teeth, anterior third of labral teeth stretched out on constricted, depressed, hemicircular area; remainder sharp, outer lip bevelled inwards, with teeth extending across the bevelled inner portion and a very short distance externally onto the labrum; no colour pattern preserved, under UV light some axially elongated blotches seen in two specimens, but no clear pattern.

Shell Formula. 45.5 (58.0 – 45.7) 20: 24

specimen	collection number	length	Width	Height	LT	CT
holotype (Figs 37-40)	NHMW 2010/0036/0002	56.0	33.3	25.6	29	33
paratype 1 (Figs 41-44)	NHMW 2010/0036/0003	42.0	23.8	18.9	24	29
paratype 2	NHMW 2010/0036/0004	38.5	22.1	17.9	24	28

Table 3. Dimensions and number of teeth; *Luria cantaurana* n. sp.



Text-figure 1. *Luria cantaurana* n. sp. Holotype NHMW 2010/0036/0002 (NMMW coll.; ex. BL coll.), length 56.0 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Luria cantaurana* n. sp. is by far the largest *Luria* species of the Cantaure Formation. As can be seen from the shell formulae, it differs from *L. fossula* (shell formula; 43.0 (60.4 – 48.8) 22: 16) in having significantly fewer columellar teeth, whereas *L. dominicensis* (shell formula; 39.5 (59.4 – 48.1) 30: 25) has a similar number of columellar teeth, but a far greater number of labral teeth. The early Miocene *L. dockeryi* from the Chipola Formation of Florida cannot be separated from *L. dominicensis* on the basis of the shell formula (see below).

Dolin (1991) synonymised *Cypraea fossula* Ingram, 1947 with *Cypraea dominicensis* Gabb, 1873. However, *Cypraea fossula* belongs within the genus *Trona* (see below). *Luria dominicensis* (LT 36, CT 29, Pilsbry, 1922; shell formula 39.5 (58.7 – 48.1) 30: 24), from an unknown locality in the Dominican Republic). The species from the early Miocene Chipola Formation of Florida originally identified as *Luria dominicensis* by Dolin (1991) was renamed *Luria (Tessellata) dockeryi* Dolin & Lozouet, 2004. *Luria dockeryi* has numerous short teeth (LT 36, CT 29, Dolin, 1991; shell formula 39.5 (59.4 – 48.1) 30: 25). The shell formula is identical to that of the holotype of *Luria dominicensis*. Unfortunately the holotype (ANSP 3003) illustrated by Pilsbry (1922) cannot be located. Dolin & Lozouet (2004) renamed the Chipola species without mentioning how it differed from the Dominican taxon. There is little to distinguish the two, from the scant material available, and they may be synonyms.

Jousseaumea joossi Schilder, 1939 (p. 23, fig. 23) was synonymised with *Luria dominicensis* by Dolin (1991). The holotype is an internal cast from the Miocene of Trinidad representing an indeterminable *Luria* sp., and it should be considered *nomen dubium*.

Etymology. Named for the Cantaure Formation.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

Luria isabellaprimitiva n. sp.
Text-figure 2; Figs 45-53

1965 *Cypraea* aff. *isabella* Linné – Jung, p. 501, pl. 67, figs 7-8.

Dimensions and type material. Holotype; NHMW 2010/0036/0005, length 27.7 mm (Figs 45-49); paratype 1 NHMW 2010/0036/0006, length, 26.6 mm (Figs 50-53); paratype 2 NHMW 2010/0036/0007, length, 26.4 mm.

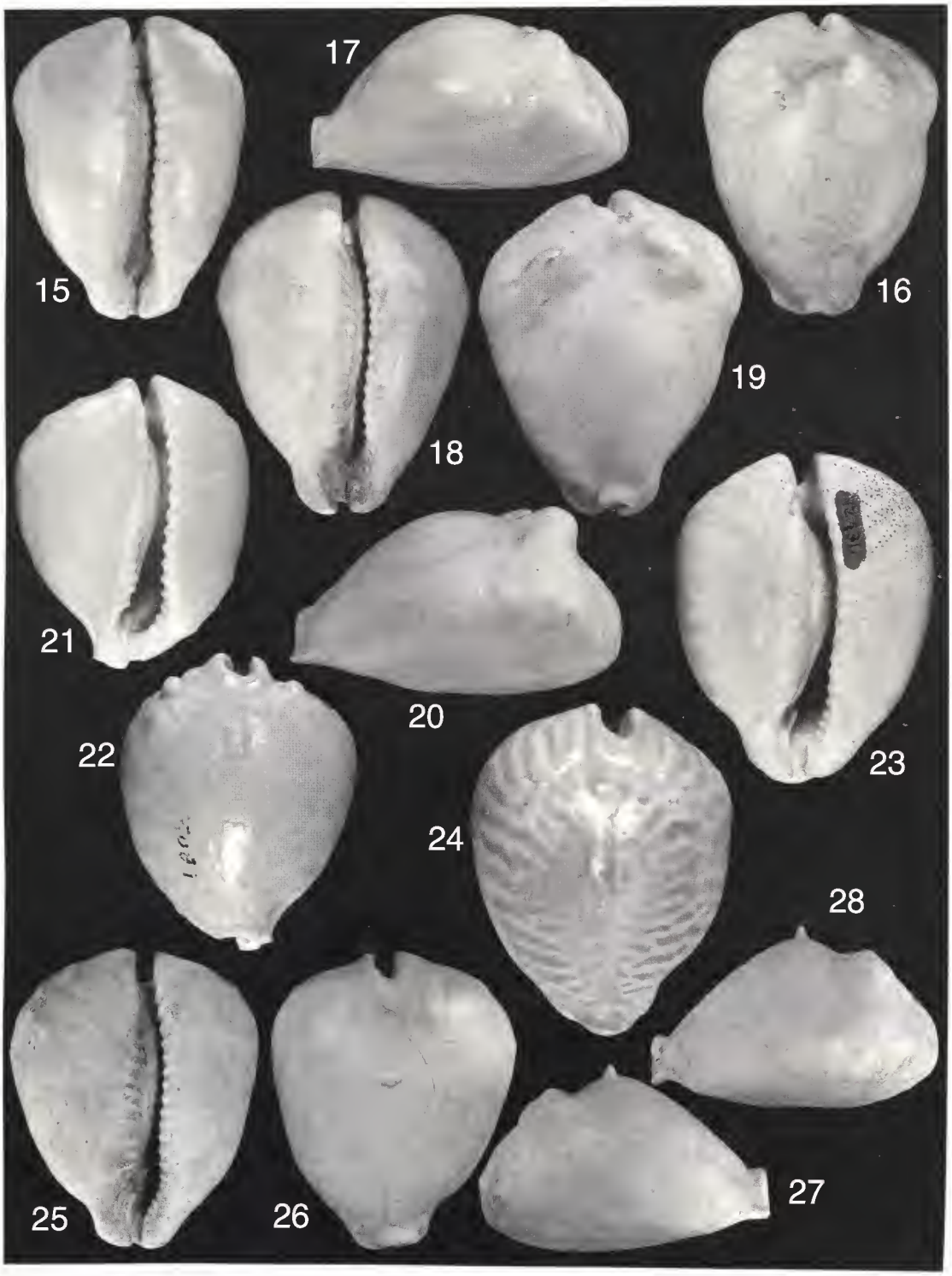
Other material. 4 specimens BL coll.

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Figures 15-28

15-17. *Muracypraea henekeni* (G. B. Sowerby I, 1850) NHMW 2010/0036/0027 (NMMW; ex. BL coll.), length 53.6 mm. TU1219, lower Gurabo Formation, early Pliocene, Gurabo River, Dominican Republic; **18-20.** *Muracypraea henekeni* (G. B. Sowerby I, 1850) NHMW 2010/0036/0028 (NMMW; ex. BL coll.), length 51.7 mm. TU1219, lower Gurabo Formation, early Pliocene, Gurabo River, Dominican Republic; **21-22.** *Muracypraea woodringi* n. sp. Paratype 1 ANSP 315087, length 42.1 mm. Lower Gatun Formation (middle Miocene), Cativa, Colón Province, Panama (photo Lindsey Groves); **23-24.** *Muracypraea woodringi* n. sp. Holotype LACMIP 12431, length 42.1 mm. Angostura Formation (upper Miocene), Loc. LACMIP 16943 [= TU 1507], just east of Río Verde, approximately 30 km east of Río Esmeraldas Esmeraldas Province, Ecuador (photo Lindsey Groves); **25-28.** *Muracypraea woodringi* n. sp. Paratype 3 NHMW 2010/0036/0001 (NMMW; ex. BL coll.), length 43.4 mm. Lower Gatun Formation (middle Miocene), Loc TU 961, roadcuts both sides of Boyd-Roosevelt Highway, just east of Cativa (= Woodring locality no. 138e), Colón Province, Panama.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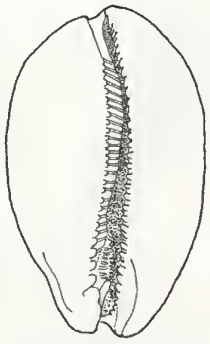
Description. Shell small for genus, solid, subcylindrical, slightly posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire involute, covered by adapical callus; sides rounded, callused, the callus extending to ⅓ height; ventrum flattened, very slightly convex in profile at the extremities; aperture straight, weakly curved to the left in the posterior portion, anteriorly somewhat dilated by hemispherical expansion on the labrum; siphonal canal deep and narrow, abaxially asymmetrical and abapically orthogonally truncated; exhalant channel deep and narrow, limited by parallel lips; 25-30 very short columellar teeth running deep into the aperture from the angulation across the columellar peristome, but not onto the ventrum; angulation relatively sharp; terminal ridge weakly developed, merged into abapical edge; fossula well-delimited from the columellar peristome by an oblique ridge, spoon-like, concave, strongly ridged, ridges ending as denticles at its inner edge; columella peristome very steep, ridged; 20-25 very short, sharp, labral teeth, abapically teeth not stretched out onto constricted, depressed, hemicircular area; teeth extending across inner portion of lip, but not externally onto the labrum; colour pattern indicating preserved spots on margins and rings on the dorsum (Fig. 49).

Shell Formula. 25.8 (64.7 – 51.6) 27: 25

Specimen	collection number	Length	Width	height	LT	CT
holotype (Figs 45-49)	NHMW 2010/0036/0005	27.7	17.0	14.2	30	24
paratype 1 (Figs 50-53)	NHMW 2010/0036/0006	26.6	16.9	13.4	28	25
paratype 2	NHMW 2010/0036/0007	26.4	17.2	14.1	24	27
BL coll. 4		28.8	17.6	14.2	29	25
BL coll. 5		27.9	17.2	12.8	26	25
BL coll. 6		26.3	15.9	13.1	28	#
BL coll. 7		22.1	15.0	11.4	23	#

Table 4. Dimensions and number of teeth; *Luria isabellaprimitiva* n. sp.

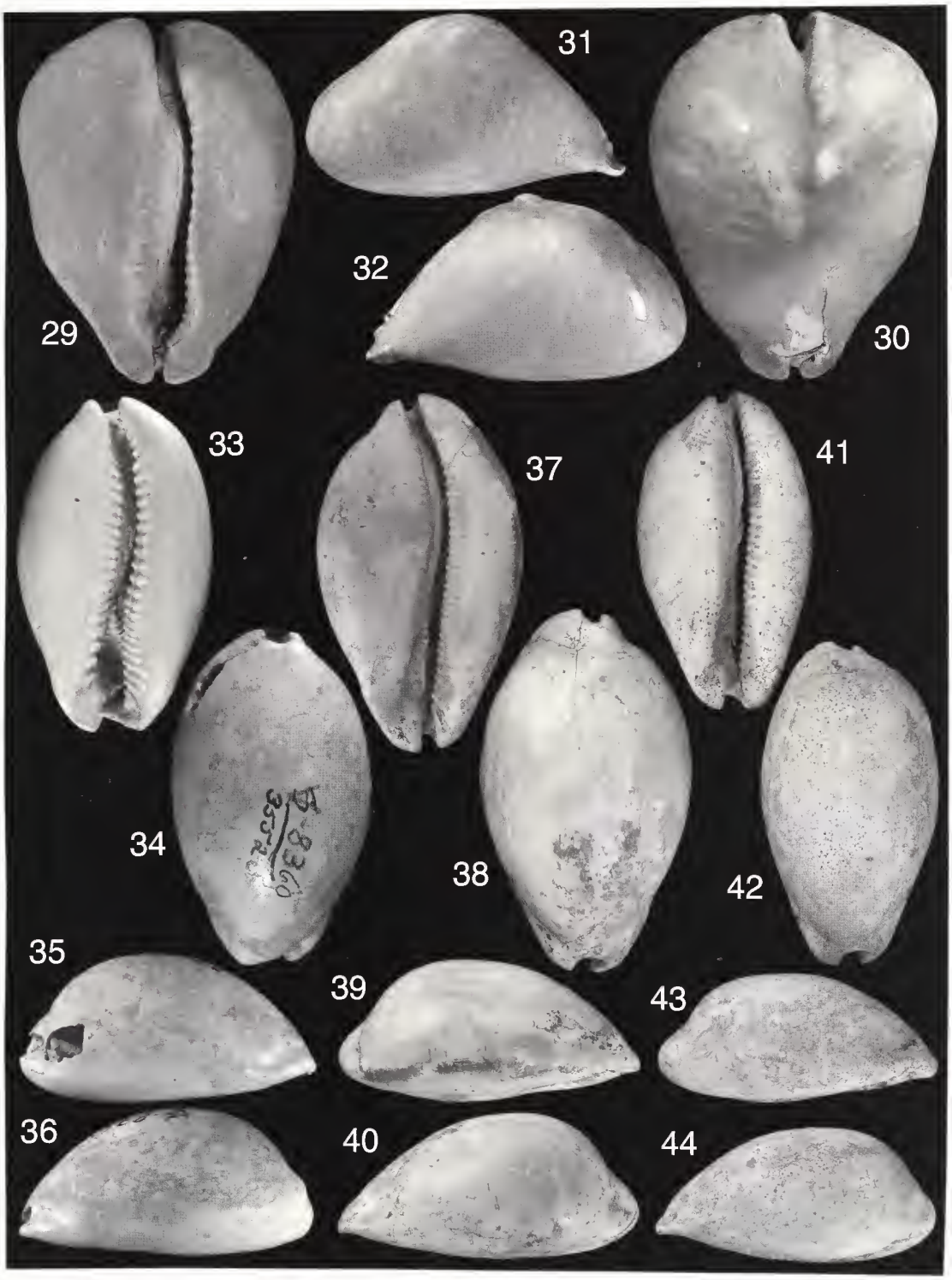


Text-figure 2. *Luria isabellaprimitiva* n. sp. Holotype NHMW 2010/0036/0005 (NMMW coll.; ex. BL coll.), length 27.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Luria isabellaprimitiva* n. sp. differs from its Cantaure Formation congener *L. cantaurana* n. sp. in having a smaller, more subcylindrical shell, with shorter extremities, and a smaller, deeper fossula. The colour pattern is somewhat unusual in consisting of circles, similar to that seen in the Recent *Arestorides argus* (Linnaeus, 1758). This is not a colour pattern present in any living or fossil species of *Luria*. The ocellated spots are not very clear and only visible on part of the holotype, and not on any of the paratypes. If this pattern were found on more specimens placement within the genus *Arestorides* Iredale, 1930 might be supported, although there is no record so far of this genus in the American Neogene to Recent faunas.

Figures 29-44

29-32. *Muracypraea grahami* (Ingram, 1947) NHMW 2010/0036/0029 (NMMW; ex. BL coll.), length 63.2 Araya Formation, Cubagua Group, early Pliocene, Cañon de las Calderas, Cubagua Island, Nueva Esparta State, Venezuela; **33-36.** *Trona trinitatensis* (Mansfield, 1925). UCMP 35536, holotype of *Cypraea fossula* Ingram, 1947. length 43.0 mm. 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **37-40.** *Luria cantaurana* n. sp. Holotype NHMW 2010/0036/0002 (NMMW; ex. BL coll.), length 56.0 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **41-44.** *Luria cantaurana* n. sp. Paratype 1 NHMW 2010/0036/0003 (NMMW; ex. BL coll.), length 42.0 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.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In the character of its subcylindrical shape and very short extremities Jung (1965) was correct to suggest that *L. isabellaprimitiva* belonged within the *L. isabella*-group. This is represented in the tropical American fossil assemblages by *L. patrespatriae* (Maury, 1917) (holotype; Fig. 146), which is found in the Lower Pliocene Gurabo Formation of the Dominican Republic. Schilder (1939) recorded *L. patrespatriae* in the Cantaure Formation. Pilsbry (1922) synonymised this taxon with the living *L. isabella* (Linnaeus, 1758), which today is widespread in the Indo-Pacific (Lorenz & Hubert, 2000). Ingram (1947) reaffirmed the synonymy whilst Woodring (1928) considered it a subspecies of *L. isabella*.

We have compared specimens of *L. patrespatriae* from the early Pliocene Gurabo Formation of the Dominican Republic with specimens *L. isabella* from the Red Sea (BL coll.). Unfortunately, the Dominican shells are fragile, including the holotype, and in almost all our specimens the columella is pushed inwards and the teeth are uncountable. We have one undamaged specimen in which the apertural characters are well preserved (Figs 54-57). The shell formula for *L. patrespatriae* [32.4 (54.0 – 44.0) 32: 29] is almost identical to that of *L. isabella* [35 (52.9 – 44.0) 34: 29]. One specimen from the Dominican Republic has the colour pattern preserved, which shows the same orange coloured tips seen in Recent *L. isabella*, but no black striping. On ventral view the columella is slightly more sinuous in *L. patrespatriae* and the terminals, especially the posterior terminal, is slightly more produced. The relationship between these species within the *L. isabella* group is unclear, we therefore consider them distinct at full species level. *Luria isabella* has a long geologic history in the Indo-Pacific, first recorded from the early Miocene of Fiji (Ladd, 1977) as *Cypraea (Talparia) isabella lekalekana* Ladd, 1934. This taxon was synonymised with *L. isabella* by Lorenz & Hubert (2000).

This species group is represented today in the tropical American Pacific by *Luria isabellamexicana* (Stearns, 1893), which differs from *L. isabella* in having a more pyriform, less subcylindrical shell shape, fewer teeth on both inner and outer lips, more protracted terminals and a somewhat different colouration [shell formula for *L. isabellamexicana* from Île de Clipperton; ZMA coll. unnumbered lot; 39.7 (54.4 – 46.6) 29: 27]. There are also radular differences (Burgess, 1985, Lorenz, 2002).

It seems, therefore, that during the Pliocene *L. patrespatriae* was present in the Caribbean portion of the Neogene Gatunian Province and *L. isabella* in the Indo-Pacific. Following the closure of the Central American isthmus, the *L. isabella*-group disappeared from the Caribbean, and its populations in the Pacific became fragmented into a questionable number of Indo-Pacific species/subspecies with restricted geographic distributions (see Lorenz & Hubert, 2000; Lorenz, 2002) and *L. isabellamexicana* restricted to the tropical American Pacific, which is unquestionably a valid taxon. Interestingly, *L. isabellamexicana* is present and common in the Lower Pleistocene Moin Formation of Costa Rica (BL collection). At this time connections between the Pacific and Caribbean, albeit intermittent, still existed and is an example of a paciphile species (see Landau et al., 2009). The *L. isabella*-group has not so far been found in the neighbouring northern Atlantic Caloosahatchian Province.

The early Miocene shells from the Cantaure Formation were synonymised with *L. patrespatriae* by Schilder (1939). However, the two populations are different; the Cantaure shells are never as cylindrical or elongated as those of *L. isabella*, and the teeth are far less numerous and stronger than in *L. isabella* (see shell formulae above). The Cantaure Formation shells are closer in shape to those of *L. isabellamexicana*, but differ in having less protracted terminals and again fewer columellar and labral teeth. We therefore consider the Cantaure shells a distinct species *L. isabellaprimitiva* n. sp.

The genus *Luria* has also been recorded from the mid-Atlantic middle Miocene Madeira Archipelago (Lorenz & Groh, 1998). The shell of *Luria santoensis* Lorenz & Groh, 1998 is not unlike that of *L. isabellaprimitiva* in general shape, but with relatively fewer columellar teeth, a wider aperture and smooth fossula. Indeed, in the character of the fossula *L. isabellaprimitiva* does not conform well within the genus, which is characterised by shells with a smooth fossula, or almost so.

Etymology. The name indicates an early member of the *L. isabella* species-group.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

Figures 45-57

45-49. *Luria isabellaprimitiva* n. sp. Holotype NHMW 2010/0036/0005 (NMMW; ex. BL coll.), length 27.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **50-53.** *Luria isabellaprimitiva* n. sp. Paratype 1 NHMW 2010/0036/0006 (NMMW; ex. BL coll.), length 26.6 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela;
54-57. *Luria patrespatriae* (Maury, 1917) NHMW 2010/0036/0030 (NMMW; ex. BL coll.), length 30.0 mm. TU1215, lower Gurabo Formation, early Pliocene, Gurabo River, Dominican Republic.

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Genus ***Trona*** Jousseaume, 1884
Type species: *Cypraea stercoraria* Linnaeus, 1758, by original designation.

Discussion. The genera *Trona* and *Macrocypraea* Schilder, 1930, traditionally considered to be closely related and within the Cypraeinae (Lorenz & Hubert, 2000) were shown by Meyer (2004) to belong to different subfamilies; *Trona* within the Luriinae and *Macrocypraea* within the Cypraeinae. The shell characteristics of the two genera are quite different. *Macrocypraea* has a rather light shell, as opposed to the very heavy shell of *Trona*. The shell of *Macrocypraea* is elongate rather than globose, they rarely have a marginal callus as opposed to the heavy callus seen in most *Trona* species, the base is far less flattened than in *Trona*, the apertures are wide with spiny extremities, not seen in *Trona*, and the shape of the anterior expansion of the aperture is quite different. The fossula in *Macrocypraea* is not as large or spoon-shaped, nor as strongly sculptured as in *Trona* and the terminal ridge is much more prominent in *Macrocypraea*.

The genus *Trona* was previously represented by a single subspecies in the Western Hemisphere. Dolin (1991) described *Trona leporina calhounensis* from the Chipola Formation of Florida based on two specimens. *Trona* is also a characteristic component within the European Miocene cypraeid fauna. *Trona leporina* (Lamarck, 1810) from contemporary late early Miocene (Burdigalian) deposits in France (Moulin de Cabannes, St Paul-les-Dax, Landes, France; BL coll.) differs from *T. leporina calhounensis* in having a less basally flattened shell, a thicker marginal callus and thicker anterior channel callus, a more rounded inner lip, a poorly developed basal angulation with narrow adapical denticles, fossula sculptured with alternate interrupted ridges and rows of pustules, more rounded outer lip, and shorter adapical denticles. Specimens from the early Burdigalian of Le Peloua, France (BL coll.), seem slightly different, more ovate with rows of very small pustules on the fossula. Dolin (1991) commented on these small differences in fossular sculpture between populations and postulated these may be an expression of ecophenotypic variation or reproductive isolation and opted to name the Chipola Formation shells *T. leporina calhounensis* a subspecies of the European taxon without implying a close phylogenetic link between the two populations. This approach is confusing and in view of the taxonomic problems still to be resolved within the European populations and the presence of additional species in the Caribbean Neogene we consider this taxon distinct at full specific rank. *Trona trinitatensis* (Mansfield, 1925) is found in the early and middle Miocene of Venezuela, Trinidad, and Carriacou, Grenadine Islands, Lesser Antilles. *Trona trinitatensis* differs from *T. ingrami* and *T. calhounensis* in having a smaller, more elongated shell, in having much less sinuous and narrower aperture, and somewhat more crowded teeth on both labral and columellar sides (see below under *Trona trinitatensis*)

Trona ingrami n. sp.
Text-figure 3; Figs 58-70

Dimensions and type material. Holotype; NMB H18402, height 53.1 mm (Figs 58-60); paratype 1 NHMW 2010/0036/0008, height, 48.2 mm (Figs 61-64); paratype 2 NHMW 2010/0036/0009, height, 47.2 mm (Figs 65-68); paratype 3 NHMW 2010/0036/0010, height, 49.7 mm (Figs 69-70).

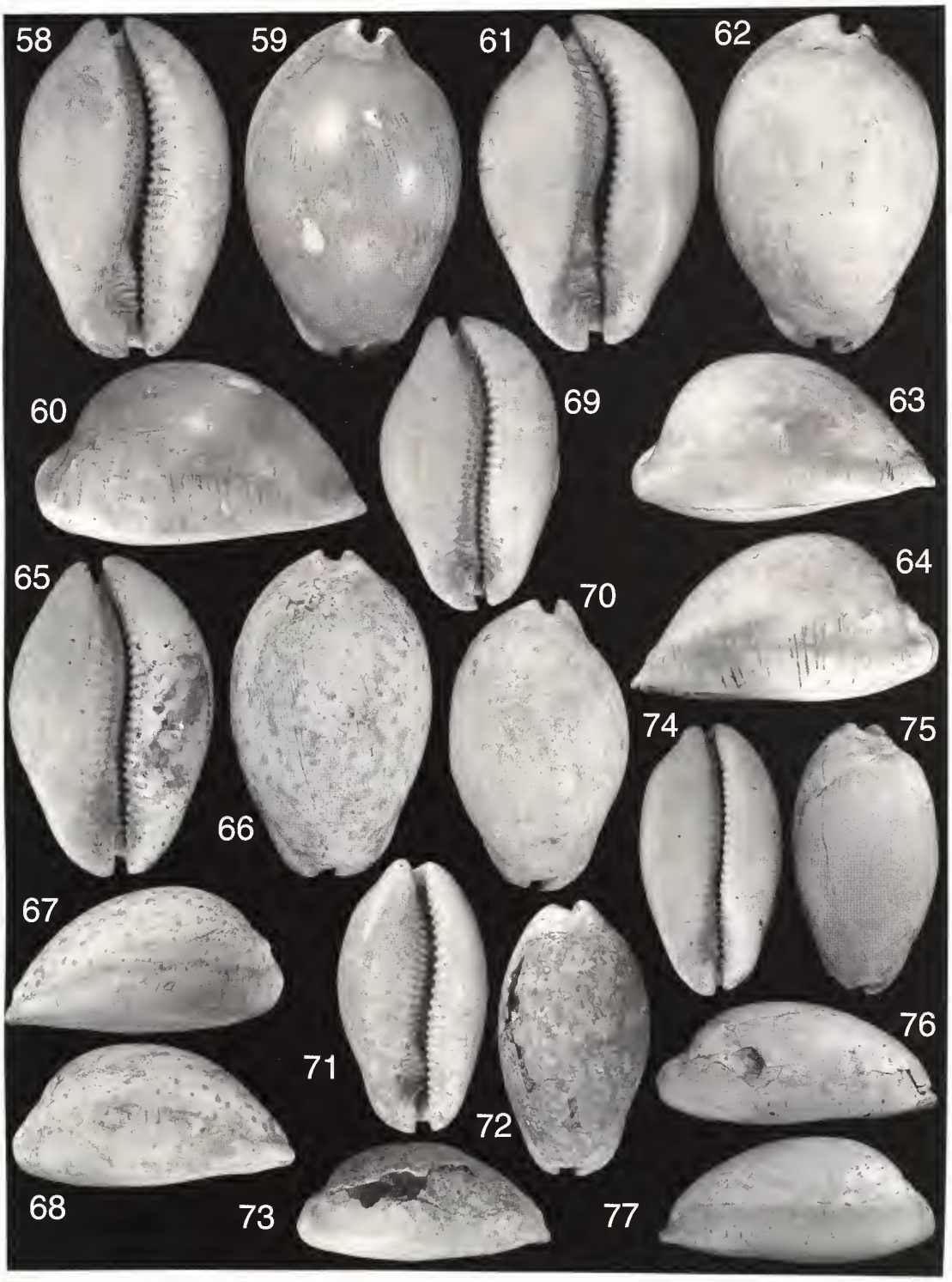
Other material. 3 specimens NMB coll.; 18 specimens BL coll.; 1 specimen DFB, no. 6578.

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Figures 58-77

58-60. *Trona ingrami* n. sp. Holotype NMB H18402 (NMB coll.), length 53.1 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **61-64.** *Trona ingrami* n. sp. Paratype 1 NHMW 2010/0036/0008 (NMMW; ex. BL coll. no. 9), length 48.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **65-68.** *Trona ingrami* n. sp. Paratype 2 NHMW 2010/0036/0009 (NMMW; ex. BL coll. no. 10), length 47.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **69-70.** *Trona ingrami* n. sp. Paratype 3 NHMW 2010/0036/0010 (NMMW; ex. BL coll. no. 15), length 49.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **71-73.** *Trona trinitatensis* (Mansfield, 1925) NMB H18403 (NMB coll.), length 33.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **74-77.** *Trona trinitatensis* (Mansfield, 1925) NHMW 2010/0036/0011 (NMMW; ex. BL coll.), length 33.0 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.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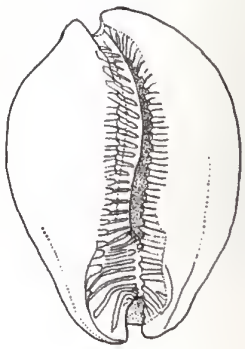
Description. Shell medium-sized for genus, solid, subcylindrical to rotund, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire weakly projecting, covered by adapical callus; sides rounded, weakly callused; ventrum flattened, slightly convex in profile; aperture parasigmoidal, anterior third dilated by hemispherical expansion; siphonal canal deep, abaxially asymmetrical and abapically orthogonally truncated; exhalant channel deeper, limited by parallel lips; four or five anterior columellar teeth, most anterior thinnest, strengthening adapically; other numerous inner teeth parallel, extending deep within the aperture, bituberculate, about 6 mm in length in the columellar area, abrupt, extending a short distance over the angulation of the basal and columellar planes onto the ventrum where they are slightly coarser; terminal ridge obsolete, merged into abapical edge, fringed with denticles from fossula on inner margin; fossula deep, concave, spoon-like, covered by narrow ridges, sometimes interrupted, joining fossular denticulation to anterior columellar teeth; 22-30 labral teeth, anterior third of labral teeth stretched out on constricted, depressed, hemicircular area; remainder heavier, outer lip bevelled inwards, with teeth extending across the bevelled inner portion, 3-4 mm in length; ventral and dorsal zones spotted, marginal callus lighter coloured, under UV light spire blotch present.

Shell Formula. 48.7 (63.0 – 50.1) 20: 18

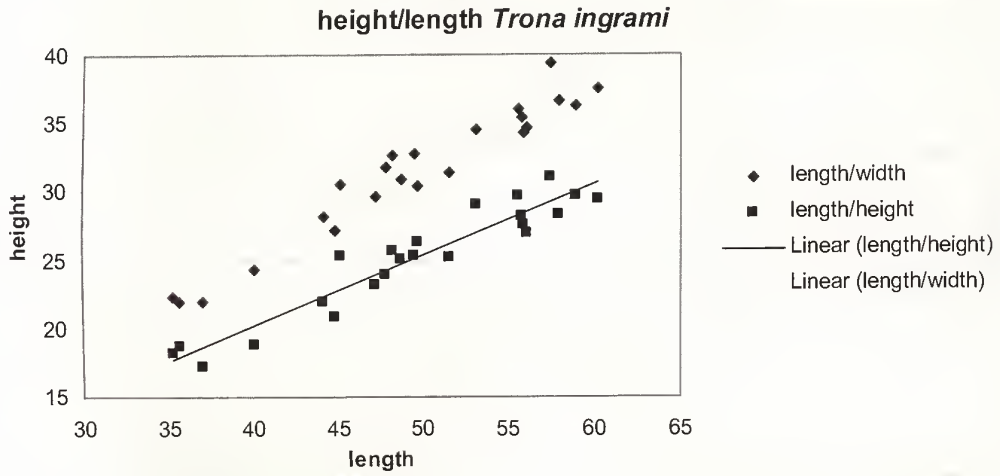
Specimen	collection number	length	width	height	LT	CT
holotype (Figs 58-60)	NMB H18402	53.1	34.5	29	23	20
NMB lot 17516		35.3	22.4	18.2	22	17
NMB lot 17516		35.7	22	18.7	#	#
NMB lot 17516		43	26.8	#	23	26
paratype 1 (Figs 61-64)	NHMW 2010/0036/0008	48.2	32.6	25.7	23	23
paratype 2 (Figs 65-68)	NHMW 2010/0036/0009	47.2	29.7	23.2	23	25
paratype 3 (Figs 69-70)	NHMW 2010/0036/0010	49.7	30.4	26.3	25	24
BL coll. 1		57.9	36.7	28.3	26	23
BL coll. 2		56.1	34.6	26.9	27	21
BL coll. 3		55.8	35.4	28.2	27	24
BL coll. 4		58.9	36.3	29.7	24	23
BL coll. 5		57.4	39.4	31.1	23	20
BL coll. 6		55.9	34.3	27.6	23	21
BL coll. 7		55.6	36	29.7	26	23
BL coll. 8		60.2	37.5	29.4	30	28
BL coll. 11		48.7	30.9	25.1	22	25
BL coll. 12		47.8	31.8	24	23	20
BL coll. 13		45.1	30.6	25.3	23	20
BL coll. 14		44.2	28.2	22	24	22
BL coll. 16		44.8	27.2	20.9	25	26
BL coll. 17		51.5	31.4	25.2	25	23
BL coll. 18		49.5	32.8	25.3	24	21
BL coll. 19		40.1	24.3	18.9	25	22
BL coll. 20		37.1	22	17.3	24	26
BL coll. subadult 21		39.5	25.1	18.8	25	24
DFB coll.	no. 6578	55.1	38.4	30.4	24	17

Table 5. Dimensions and number of teeth; *Trona ingrami* n. sp.



Text-figure 3 (opposite). *Trona ingrami* n. sp. Paratype 1 NHMW 2010/0036/0008 (NMMW coll.; ex. BL coll. no. 9), length 48.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela

Discussion. *Trona ingrami* n. sp. has a rather variable shell shape. The larger specimens tend to be more rotund and broad (Figs 58-64), whereas the smaller specimens have a more elongated aspect and a less sinuous aperture, but intermediate specimens also occur (see Text-figure 4). The single living representative of the genus *Trona stercoraria* (Linnaeus, 1758) distributed today along the coast of tropical West Africa also has a variable shell shape (Lorenz & Hubert, 2000; pl. 11). Dolin (1991) hints at sexual dimorphism in the species without elaborating, however, in Cypraeidae as well as in Ovulidae male shells tend to be smaller than females.



Text-figure 4. Height/ Length; *Trona ingrami* n. sp.

Dolin (1991) describes a light-weight shell with uncallused margins, whereas the Cantaure shells are very solid with a weakly developed marginal callus. His description and figure clearly show the labral teeth to be restricted to the inside of the aperture, whereas the teeth in *T. ingrami* extend a short distance over the basal plane onto the ventrum where they become somewhat coarser. On the labral side the teeth abapically are described as short, whereas in *T. ingrami* the outer lip is bevelled inwards with the teeth extending across the bevelled inner portion. The fossula in *T. ingrami* has few elongated denticles which tend to be continuous and rarely tubercles as compared to the specimens of *T. calhounensis* figured by Dolin (1991) (fig. 22a) which has the fossula crowded with interrupted ridges and elongated tubercles.

Etymology. Named for William Marcus Ingram in recognition of his pioneering work on Caribbean Neogene cypraeids.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

Trona trinitatensis (Mansfield, 1925)
Text-figure 5; Figs 71-77

1925 *Cypraea trinitatensis* Mansfield, p. 49, pl. 8, fig. 10.
1939 *Trona (Macrocypraea) trinitatensis* Mansfield, 1925 – Schilder (partim?), p. 30, fig. 32.
1947 *Cypraea fossula* Ingram, p. 4 (128), pl. 1 (8), fig. 3.
1971 *Macrocypraea cervinetta fossula* Ingram, 1947 – Schilder & Schilder, p. 33.
1971 *Macrocypraea trinitatensis* Mansfield, 1925 – Schilder & Schilder (partim?), p. 164.
?1971 *Macrocypraea* aff. *zebra* (Linné) – Jung, p. 181, pl. 8, figs 1-3.
1993 *Macrocypraea trinitatensis* (Mansfield, 1925) – Lorenz & Herbert, pl. 121, fig. 3.
2000 *Macrocypraea trinitatensis* (Mansfield, 1925) – Lorenz & Herbert, pl. 121, fig. 3.
2004 *Luria (Tessellata) fossula* (Ingram, 1947) – Dolin & Lozouet, p. 20.

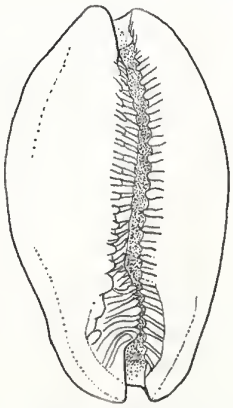
Material. 1 specimen NMB H18403, NMB coll. (Figs 71-73); 1 specimen NHMW 2010/0036/0011, NHMW coll. (ex. BL coll.) (Figs 74-77). Holotype of *C. fossula*; UCMP 35536.

Description. Shell small for genus, solid, subcylindrical, weakly posteriorly swollen, spire projecting, covered by adapical callus; sides angular to rounded, callused; ventrum almost flat; aperture weakly parasigmoidal, anterior third dilated by hemispherical expansion; siphonal canal deep, abaxially asymmetrical and abapically orthogonally truncated; exhalant channel deeper, limited by parallel lips; four anterior columellar teeth; other numerous inner teeth parallel, extending deep within the aperture, bituberculate, abrupt, not extending over the angulation onto the ventrum; terminal ridge obsolete, merged into abapical edge, fringed with denticles from fossula on inner margin; fossula deep, concave, spoon-like, covered by narrow ridges, sometimes interrupted, joining fossular denticulation to anterior columellar teeth; 22-27 labral teeth, anterior third of labral teeth stretched out on constricted, depressed, hemicircular area; remainder heavier, outer lip bevelled inwards, with teeth extending across the bevelled inner portion; no colour pattern preserved, under UV light spots present on marginal callus.

Shell Formula. 33.2 (55.8 – 44.0) 22: 20

specimen	collection number	length	Width	height	LT	CT
Figs 71-73	NMB H18403	33.3	18.8	15.3	22	21
Figs 74-77	NHMW 2010/0036/0011	33.0	18.3	13.9	27	22
Figs 33-36	UCMP 35536	43.0	26.0	21.0	27	19

Table 6. Dimensions and number of teeth; *Trona trinitatensis* n. sp.



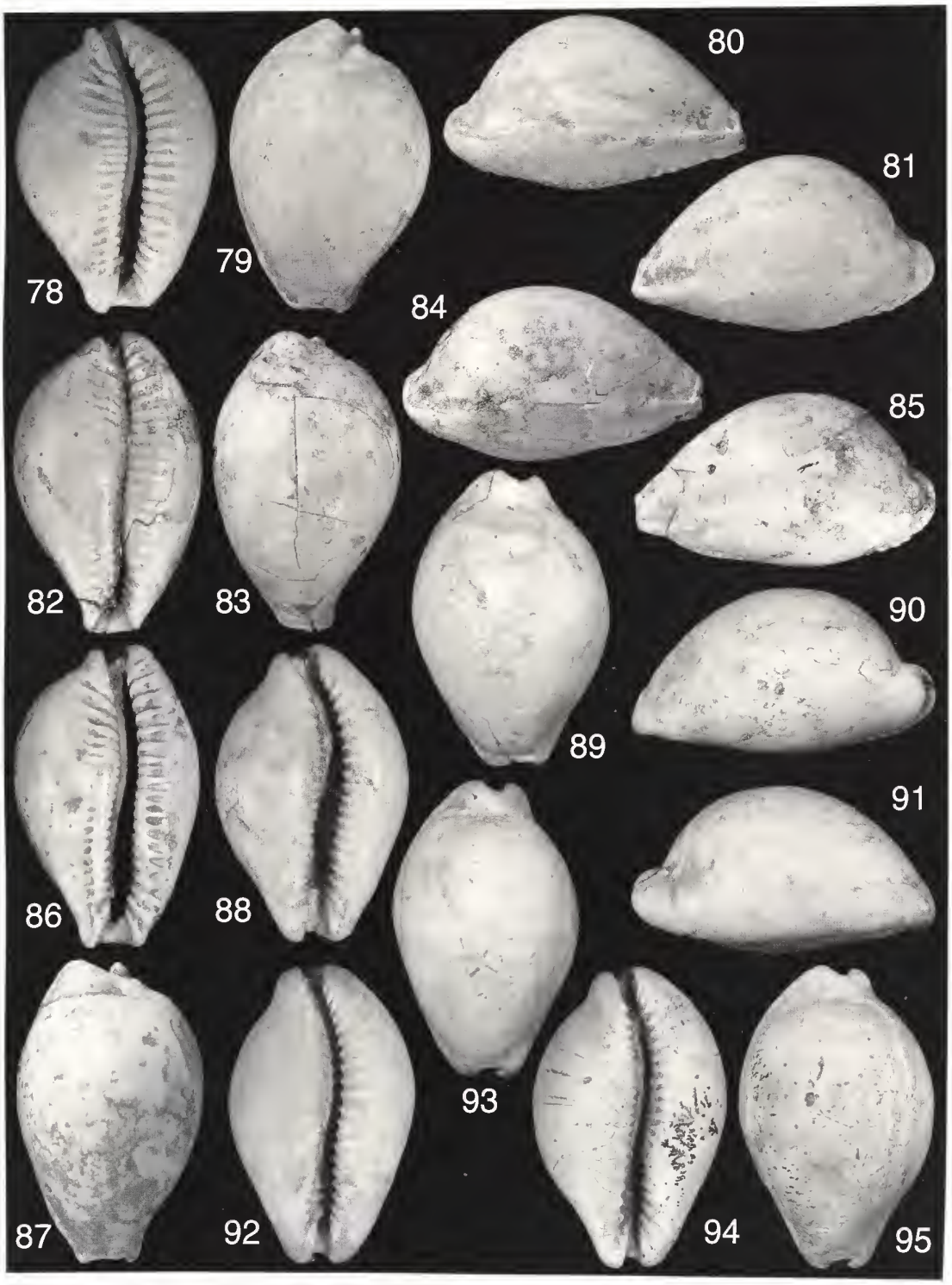
Text-figure 5. *Trona trinitatensis* (Mansfield, 1925) NMB H18403 (NMB coll.), length 33.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. The holotype of *Trona trinitatensis* (Mansfield, 1925) is an internal mould collected from the Guaracara Limestone Member of the late early to early middle Miocene Tamana Formation of Trinidad and is difficult to identify with any certainty. According to Jung (1971), all the other specimens from Trinidad recorded by Schilder (1939) are also internal moulds. Schilder (1939) also identified specimens from the middle Miocene Grand Bay Formation of Carriacou as *Trona (Macrocypraea) trinitatensis*. According to Jung (1971) it was unlikely that the Carriacou shells were conspecific with those from Trinidad and that the larger Carriacou shells were closer to the living *Macrocypraea zebra*. According to Jung they differed 'morphologically' from the shells from *T. trinitatensis* from Trinidad, but he did not specify what these differences were.

Figures 78-95

78-81. *Propustularia longidentata* n. sp. Holotype NHMW 2010/0036/0012 (NMMW; ex. BL coll.), length 15.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **82-85.** *Propustularia longidentata* n. sp. Paratype 1 NHMW 2010/0036/0013 (NMMW; ex. BL coll.), length 14.5 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **86-87.** *Propustularia longidentata* n. sp. Paratype 2 NHMW 2010/0036/0014 (NMMW; ex. BL coll.), length 12.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **88-91.** *Propustularia paraguanensis* n. sp. Holotype NHMW 2010/0036/0015 (NMMW; ex. BL coll.), length 17.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

92-93. *Propustularia paraguanensis* n. sp. Paratype 1 NHMW 2010/0036/0016 (NMMW; ex. BL coll.), length 17.8 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **94-95.** *Propustularia paraguanensis* n. sp. Paratype 2 NHMW 2010/0036/0017 (NMMW; ex. BL coll.), length 16.1 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.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Although ascribed by various authors to the genus *Macrocypraea*, *Cypraea trinitatensis* belongs within the genus *Trona* (see generic discussion above). Unfortunately the fossula is covered by matrix in the Schilder (1939) and Jung (1965) specimen from Carriacou, however, the shape of the dilated hemispherical expansion on anterior third of the aperture and the absence of spines on the siphonal canal indicate they are also *Trona*. *Trona trinitatensis* differs from *T. ingrami* by its smaller shell (at least in Cantaure, although the Trinidad and Carriacou shells are larger), more elongated cylindrical shape, much less sinuous and narrower aperture, and somewhat more crowded teeth on both labral and columellar sides. The re-illustration of the holotype of *Cypraea fossula* Ingram, 1947 (Figs 33-36) clearly show it to belong within the genus *Trona* and not *Luria* as suggested by Dolin (1991) and Dolin & Lozouet (2004). The shell is slightly broader than our other two specimens of *T. trinitatensis*, but less inflated than *T. ingrami*, also the columellar density is slightly less than typical *T. trinitatensis*, but probably within the variability of this species. We therefore consider *C. fossula* a junior subjective synonym of *T. trinitatensis*.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela; Tamana Formation, Trinidad.
Middle Miocene: Grand Bay Formation of Carriacou.

Subfamily **EROSARIINAE** Schilder, 1924
Genus ***Propustularia*** Schilder, 1927
Type species: *Cypraea surinamensis* Perry, 1811, by original designation.

Discussion. Schilder (1939) and Schilder & Schilder (1971) assigned a small group of tropical American cypraeids to the genus *Pustularia* Swainson, 1840 (ie., *P. mejasensis*, *P. americana*, *P. caribaea* all Schilder, 1939, and *C. guraboniis* Ingram, 1939). However, their shells do not conform to the generic characteristics of the Recent Indo-Pacific *Pustularia* species. The fossil taxa all have shells with far less pronounced rostration of the extremities which do not carry the spines so characteristic of the Recent species. Lorenz (1999) also observed that the posterior extremity composed of a callus-accumulation and two marginal spines formed by the posterior terminal ridges, seen in the Recent species, is not found in any of the Caribbean fossil species assigned by Schilder & Schilder (1971) to *Pustularia*. The fossula is narrow and smooth in all Recent *Pustularia* species, whereas it is denticulate in the Neogene Caribbean species. Most of this group of species share more shell characteristics with the genus *Propustularia* Schilder, 1927, which is today represented by a single taxon *Propustularia surinamensis* (Perry, 1811) found in the Caribbean. *Propustularia* is characterised by pyriform-inflated shells, with somewhat rostrate extremities, a weakly produced spire and fine teeth. *Pustularia americana* (holotype; Figs 147-150), on the other hand, shows the shell characteristics of the genus *Erosaria* Schilder, 1924. Lorenz (1999) and Lorenz & Hubert (2000) synonymised *Propustularia* with *Proadusta* Sacco 1894, and suggested *Pustularia* might have evolved from *Proadusta*-like forms. *Propustularia longidentata* n. sp. (herein) also shares some shell characteristics with the deep water Indo-Pacific and southeast African genus *Nesiocypraea* Azuma & Kurohara, 1967, particularly the species *N. lisetae* Kilburn, 1972. These characteristics include globular shape, distinctly curved aperture in the posterior third, denticulate fossula, and a callus bridge, in *Nesiocypraea* connecting both, labral and columellar teeth. In *Nesiocypraea*, however, the teeth are short and do not extend onto the ventrum or outer lip. Meyer's (2004) molecular work on cypraeids placed the clade consisting of *Propustularia*, *Nesiocypraea* and *Ipsa* as basal to all cowries.

***Propustularia longidentata* n. sp.**
Text-figure 6; Figs 78-87

Dimensions and type material. Holotype; NHMW 2010/0036/0012, height 15.2 mm (Figs 78-81); paratype 1; NHMW 2010/0036/0013, height 14.5 mm (Figs 82-85); paratype 2; NHMW 2010/0036/0014, height 12.2 mm (Figs 86-87).

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Type stratum. Cantaure Formation (early Miocene: Burdigalian).

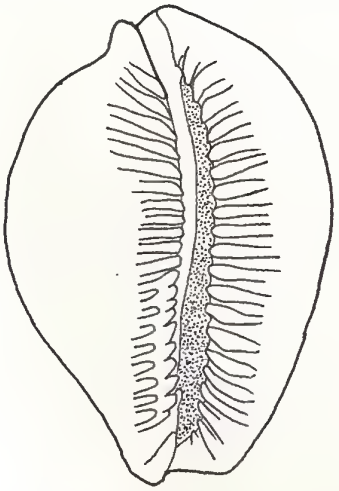
Description. Shell small for genus, fragile, globular, posteriorly swollen, spire weakly projecting, covered by adapical callus, extremities moderately projecting; sides rounded, moderately callused, lip marginal callus sharply delimited and slightly raised; ventrum flattened, convex in profile; aperture narrow, edges parallel, conspicuously curved to the left in the posterior third; siphonal canal moderately long, externally barely margined; exhalant channel moderately produced, strongly bent adaxially, externally barely margined; terminal ridge well-developed, tooth-like at its inner extremity; fossula narrow, hardly delimited from the rest of the columella, bearing narrow elongated extensions of the labral teeth; teeth on both sides well developed, 21-22 columellar teeth, anterior columellar teeth fused at the angulation, forming an elevated vertical callus bridge, mid-height the teeth weaken or subobsolete, again strongly developed in the posterior portion, teeth extending onto the ventrum especially in the anterior and posterior portions, inwards the teeth hardly extend onto the columella, columella smooth; 20-23 labral

teeth extending just over half of the labral width. No dorsal sulcus, pustules or pitting present. Colour pattern not preserved, under UV light suggestion of large spots on the dorsum.

Shell Formula. 14.0 (66.4 – 55.7) 26: 26

Specimen	collection number	length	width	height	LT	CT
Holotype (Figs 78-81)	NHMW 2010/0036/0012	15.2	10.8	8.7	20	22
Paratype 1 (Figs 82-85)	NHMW 2010/0036/0013	14.5	9.4 (distorted)	8.3	23	21
Paratype 2 (Figs 86-87)	NHMW 2010/0036/0014	12.2	7.6	6.5	20	21

Table 7. Dimensions and number of teeth; *Propustularia longidentata* n. sp.



Text-figure 6. *Propustularia longidentata* n. sp. Holotype NHMW 2010/0036/0012 (NMMW coll.; ex. BL coll.), length 15.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. Several Neogene Caribbean forms have been described. *Pustularia mejasensis* Schilder, 1939 from Trinidad is represented by a single internal mould. However, because it is impossible to determine what taxon this represents it should be considered *nomen dubium*. *Pustularia americana* Schilder, 1939 from the early Miocene of Cuba has a more solid shell, with less produced, extremities, wider siphonal channel, fewer columellar and labral teeth, which on the columellar side to not extend onto the ventrum and pustules on the dorsum adjacent to the labral marginal callus, and is better placed in the genus *Erosaria*. *Propustularia caribaea* (Schilder, 1939) (holotype; Figs 151-154) from the early Middle Miocene Grand Bay Formation of Carriacou is extremely similar to *P. longidentata* [shell formula 13.5 (64 – 50) 28: 23], but no bridge is developed between the anterior columellar teeth.

Etymology. named for the long teeth, seen especially in the holotype.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela

***Propustularia paraguanensis* n. sp.**
Text-figure 7; Figs 88-95

Dimensions and type material. Holotype; NHMW 2010/0036/0015, height 17.2 mm (Figs 88-91); paratype 1; NHMW 2010/0036/0016, height 17.8 mm (Figs 92-93); paratype 2; NHMW 2010/0036/0017, height 16.1 mm (Figs 94-95).

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

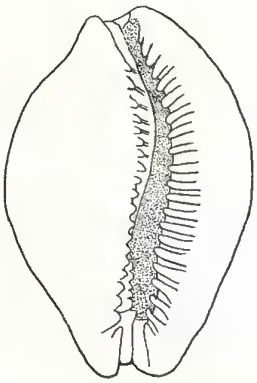
Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell small for genus, solid, globular, weakly swollen posteriorly, spire involute, covered by adapical callus, extremities weakly projecting; sides rounded, moderately callused, lip marginal callus sharply delimited and slightly thickened; ventrum flattened, weakly convex in profile; aperture narrow, edges parallel, conspicuously curved to the left in the posterior third; siphonal canal moderately long, externally barely margined; exhalant channel moderately produced, strongly bent adaxially, externally barely margined; terminal ridge well-developed, tooth-like at its inner extremity; fossula narrow, weakly delimited from the rest of the columella, labral teeth extend across the fossula as elevated ridges and form teeth again at the inner edge of the fossula; 19-20 short columellar teeth, not extending past the angulation onto the ventrum; 20-22 labral teeth extending less than half of the labral width. No dorsal sulcus, pustules or pitting present. Colour pattern not preserved, under UV light suggestion large irregular spots on the posterior portion of the dorsum, the spots much wider than the distance between them.

Shell Formula. 17.0 (67.1 – 51.8) 25: 22

specimen	collection number	length	width	height	LT	CT
Holotype (Figs 88-91)	NHMW 2010/0036/0015	17.2	11.7	9.1	20	19
Paratype 1 (Figs 92-93)	NHMW 2010/0036/0016	17.8	11.5	9.0	22	20
Paratype 2 (Figs 94-95)	NHMW 2010/0036/0017	16.1	11.0	8.3	22	20

Table 8. Dimensions and number of teeth; *Propustularia paraguanensis* n. sp.



Text-figure 7. *Propustularia paraguanensis* n. sp. Holotype NHMW 2010/0036/0015 (NMMW coll.; ex. BL coll.), length 17.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Propustularia paraguanensis* n. sp. differs from *P. longidentata* n. sp. in its less posteriorly swollen shell shape, more strongly sculptured fossula and shorter teeth on both labral and columellar sides. There is no trace of the callus bridge so prominently developed in *P. longidentata*. *Propustularia bartschi* (Ingram, 1939) (holotype; Figs 155-156) from the early Pleistocene of Costa Rica is most similar to paratype 2 of *P. paraguanensis* (Figs 94-95) in overall shape but the widest portion of the shell is more posterior in *P. bartschi*. The dentition seems to be the same in all of the figured type specimens but the aperture is most similar to paratype 1 (Figs 92-93). In the lateral views *P. bartschi* is much more tapered towards the anterior than *P. paraguanensis*.

Etymology. named after the Paraguaná Peninsula, location of the Cantaure deposits.

Geological and geographical distribution.

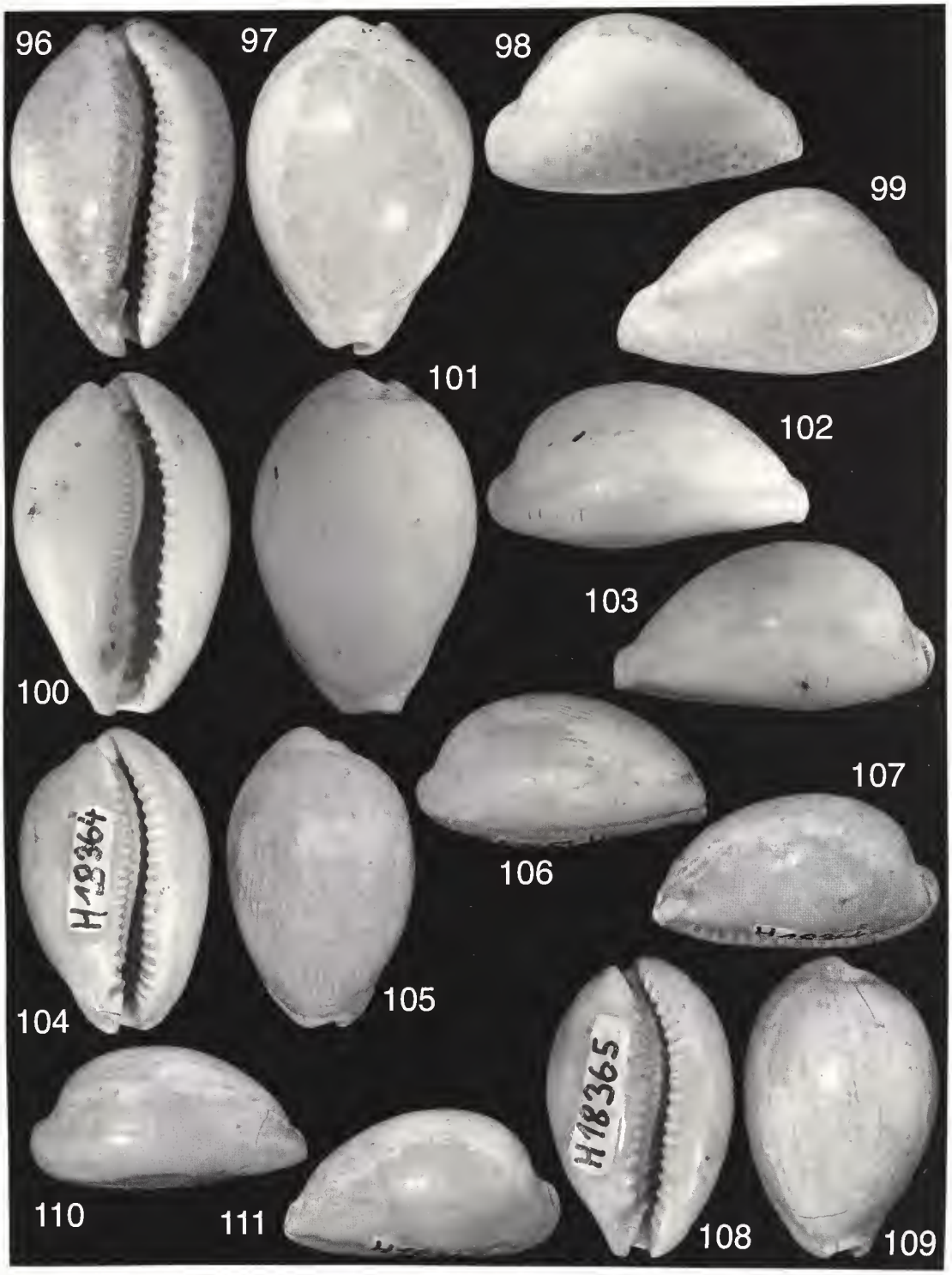
Lower Miocene: Cantaure Formation, Venezuela

Subfamily **ZONARIINAE** Schilder, 1932
Genus ***Zonaria*** Jousseaume, 1884
Type species: *Cypraea zonaria* Gmelin, 1791, by original designation.

Zonaria is tranditonally assigned to the subfamily Erroneinae Schilder, 1927. However, based on mitochondrial molecular data Meyer (2004) demonstrated that the genus belongs within a separate group; Zonariinae Schilder, 1932. *Zonaria* is characterized by species with oval to pyriform, small to moderate-sized shells, the teeth are fine and widely spaced, the fossula is much reduced, the columellar area is smooth, the callus collar surrounding the siphonal canal is well-developed and the colour pattern consists of marginal spotting and a dorsum with irregular or interrupted mottled banding. *Zonaria* has been known in Europe since the early Miocene and is distributed today in the Mediterranean and West Africa (Lorenz & Hubert, 2000). Groves (1997) reported the genus in the Pacific tropical American Neogene assemblages with the description of *Z. pittorum* Groves, 1997 (holotype; Figs 157-158) from the early Pliocene Esmeraldas beds of the Onzole Formation of Ecuador. Later Groves & Nielsen (2003) described *Z. frassinetti* (Figs 159-160) from the early late Miocene, Tortonian of Chile which is here reassigned to the genus *Pseudozonaria*. There is an additional species of *Zonaria* from the Neogene of the Dominican Republic, which awaits publication (BL coll.; unpublished data). The genus has also been recorded from the middle Miocene of the Madeira Archipelago (Lorenz & Groh, 1998).

Figures 96-111

96-99. *Zonaria pingata* n. sp. Holotype NHMW 2010/0036/0018 (NMMW; ex. BL coll.), length 45.8 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **100-103.** *Pseudozonaria praeaequinoctialis* n. sp. Holotype NHMW 2010/0036/0019 (NMMW; ex. BL coll.), length 32.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **104-107.** *Pseudozonaria primarobertsi* n. sp. Holotype NMB H18364 (NMB coll.), length 22.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **108-111.** *Pseudozonaria primarobertsi* n. sp. Paratype 1 NMB H18365 (NMB coll.), length 21.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.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H18364
H18365

The "*Pseudozonaria*" group, which is characterised by its elongate-oval shells with well developed, often sharp cut teeth, densely spotted margins, freckled dorsum and prominent extremities, is closely related. Groves (1997) considered *Pseudozonaria* a subgenus of *Zonaria*; Lorenz & Hubert (2000) used "*Pseudozonaria*" as an informal group within *Zonaria*; Landau & Silva (2010) considered the two separate at full generic rank. *Pseudozonaria* has a fossil record in the tropical American Neogene and is today restricted to the Pacific side of its original wider distribution (i.e. western side of Central America), and is an example of a Paciphile taxon (Woodring, 1966; Landau et al., 2009).

Zonaria pingata n. sp.
Text-figure 8; Figs 96-99

Dimensions and type material. Holotype NHMW 2010/0036/0018, height 45.8 mm (Figs 96-99).

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

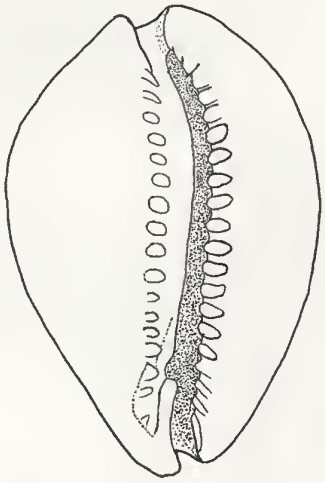
Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell medium-sized for genus, solid, ovate-pyriform, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire weakly projecting, covered by adapical callus; sides rounded, strongly callused; callus ascending above mid-height, its highest point at the dorsal hump; ventrum flattened, slightly convex in profile; aperture weakly sigmoidal; siphonal canal long, abaxially asymmetrical and recurved, externally surrounded by thick callus collar; exhalant channel weakly bent adaxially, externally surrounded by thick adapical callus; terminal ridge well-developed, tooth-like at its inner extremity; fossula smooth, marked by small depression; three anterior columellar teeth, most anterior thinnest, adapically 14 short, stout, parallel, well-spaced inner teeth, ending abruptly at the basal and columellar planes, not extending onto the ventrum nor the aperture; columella smooth; 20 heavy, regularly-spaced labral teeth; Ventral and marginal zones spotted, marginal callus lighter coloured, dorsum golden-brown with orange watermark-like stains placed in irregular bands.

Shell Formula. 45.8 (67.9 – 58.0) 17: 14

Specimen	collection number	length	width	height	LT	CT
Holotype (Figs 96-99)	NHMW 2010/0036/0018	45.8	31.1	26.1	20	17

Table 9. Dimensions and number of teeth; *Zonaria pingata* n. sp.



Text-figure 8. *Zonaria pingata* n. sp. Holotype NHMW 2010/0036/0018 (NHMW coll.; ex. BL coll.), length 45.8 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Zonaria pingata* n. sp. is described based on a single beautifully preserved specimen and is extremely rare in the Cantaure Formation. The Cantaure Formation shell differs from the early Pliocene Esmeraldas Formation *Z. pittorum* in being more globose rather than pyriform in shape, the posterior portion of the aperture is more twisted to the left in *Z. pittorum* and the teeth are longer on both sides in *Z. pittorum*. The shell formula of the two is very similar (*Z. pittorum*: 40.1 (68.0 – 52.1) 17: 15).

Zonaria pingata is most similar to *Z. zonaria* (Gmelin, 1791), the type-species of the genus, but has a more ovate shell, the inner lip teeth are shorter and stouter and the siphonal canal is more recurved. The Recent Mediterranean and West African *Zonaria pyrum* (Gmelin, 1791) is similar in shape, but the anterior third of the aperture is expanded, the inner lip teeth are again longer and the margins are uniform orange without spots. The Mediterranean Pliocene *Zonaria porcellus* (Brocchi, 1814) is easily separated by its more elongate-pyriform shape and much finer teeth, which on the inner lip become obsolete adapically.

Etymology. From Latin for stained *Zonaria*.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

***Zonaria pseudotumulus* n. sp.**
Text-figure 9; Figs 132-139

Dimensions and type material. Holotype; NMB H18360, height 27.2 mm (Figs 132-135); paratype 1 NHMW 2010/0036/0022, height, 26.4 mm (Figs 136-137); paratype 2 NHMW 2010/0036/0023, height, 22.2 mm (Figs 138-139).

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

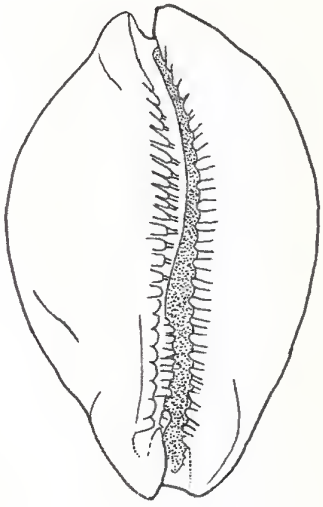
Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell medium-sized, solid, pyriform, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire involute, covered by adapical callus; sides rounded, moderately callused, callus ascending to ⅓-½ shell height; ventrum weakly convex in profile; margination (sensu Dolin & Lozouet, 2004) prominent, giving the left anterior terminal a pinched appearance; aperture of medium width, anterior portion almost straight, posteriorly curving to the left, anterior portion very slightly wider; siphonal canal relatively long, narrow, abaxially asymmetrical; exhalant channel moderately produced, limited by parallel lips; columella denticulate along entire length, bearing 22-23 short denticles, which extend as folds a short distance onto the columella peristome and a short distance across the angulation onto the ventrum; anterior portion of angulation swollen and ridge like, overhanging the fossula; anterior columellar teeth more prominent; inner ⅔ of columella peristome smooth; terminal fold oblique (sensu Schilder & Schilder, 1938), separated from the columellar teeth by a deep groove, moderately developed, bordering the siphonal canal, small internal lamina (sensu Dolin & Lozouet, 2004); fossula relatively well developed but poorly delimited, concave, very steep, ridges originating from the anterior columellar teeth run onto the fossula, become obsolete mid-fossula, which is smooth, strengthening again at the inner edge to form inner teeth; 20-27 short labral teeth developed at the lip edge, hardly running onto the labrum. Traces of spotted colour pattern preserved on the dorsum, enhanced under UV light.

Shell Formula. 25.3 (65.1 – 50.1) 23: 22

specimen	collection number	length	Width	height	LT	CT
Holotype (Figs 132-135)	NMB H18360	27.2	17.5	14.1	27	23
Paratype 1 (Figs 136-137)	NHMW 2010/0036/0022	26.4	17.4	12.3	23	22
Paratype 2 (Figs 138-139)	NHMW 2010/0036/0023	22.2	14.5	11.6	20	22

Table 10. Dimensions and number of teeth; *Zonaria pseudotumulus* n. sp.



Text-figure 9. *Zonaria pseudotumulus* n. sp. Holotype NMB H18360 (NMB coll.), length 27.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Zonaria pseudotumulus* n. sp. is closely similar to the early Miocene *Z. tumulus* (Heilprin, 1886) from the Chipola Formation of Florida, but differs in having a less globose shell, the anterior portion of the aperture is less expanded, the outer lip is not sinuous and the fossula is not as wide nor as strongly ridged as in *Z. tumulus*. *Zonaria spurcoides* (Gabb, 1873) (lectotype; Figs 161-164) from the early Miocene Baitoa Formation (Figs 140-143), early Pliocene Gurabo Formation of the Dominican Republic, and early Miocene Chipola Formation of Florida (Dolin, 1991) is even more similar, but differs most notably in the character of the anterior portion of the columella and anterior left terminal; in *Z. pseudotumulus* the anterior portion of the angulation is markedly swollen, overhanging the fossula, the strong anterior teeth extend a short distance over the fossula and are obsolete mid-fossula in the paratypes, in the holotype the anterior two ridges run right across the fossula, although weakened. In *Z. spurcoides* the anterior portion of the angulation is not as swollen, the columellar teeth are wider spaced and continuous across the fossula as narrow ridges joining the columellar teeth at the angulation with the teeth at the inner edge of the fossula. In *Z. pseudotumulus* the anterior left terminal has a pinched and somewhat

twisted appearance, constricted between the groove between the anterior terminal and first columellar tooth on the ventral side and the indented margination on the dorsum. This feature is not seen in *Z. spurcoides*. The fossula is also flatter in *Z. pseudotumulus*.

Etymology. Named reflecting similarity to *Cypraea tumulus* from the early Miocene Chipola Formation of Florida.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

Subfamily **PSEUDOZONARIINAE**
Genus ***Pseudozonaria*** Schilder, 1927.
Type species *Cypraea arabicula* Lamarck, 1810, original designation.

The "*Pseudozonaria*" group is characterised by its elongate-oval shells with well developed, often sharp cut teeth, densely spotted margins and freckled dorsum and prominent extremities. Today the group is represented by five tropical American Pacific species; *P. aequinoctialis* (Schilder, 1931), *P. annettae* (Dall, 1909), *P. arabicula* (Lamarck, 1810), *P. nigropuctata* (Gray, 1828), and *P. robertsi* (Hidalgo, 1906) (Lorenz & Hubert, 2000; Meyer, 2003, 2004). Several fossil species belonging to *Zonaria* Jousseaume, 1884 and *Pseudozonaria* Schilder, 1927 have been described from the Gatunian Neogene. *Zonaria* and *Pseudozonaria* are closely related groups, and not all cypraeid specialists are in agreement as to their rank or which species belong in which of the two groups. Groves (1997) considered *Pseudozonaria* a subgenus of *Zonaria*; Lorenz & Hubert (2000) use "*Pseudozonaria*" as an informal group within *Zonaria*, and Landau & Silva (2010) considered both valid genera.

López Soriano (2006) justified the separation of a new subfamily Pseudozonariinae from the Zonariinae Schilder, 1932 based on molecular data (Meyer, 2004), anatomical differences of the mantle and papillae, and some small differences in shell morphology. They also have distinct geographical distributions; Pseudozonariinae are tropical American, today restricted to the western side of Central America; Zonariinae are known since the Miocene in Europe and Recent of West Africa (Lorenz & Hubert, 2000).

***Pseudozonaria praeaequinoctialis* n. sp.**
Text-figure 10; Figs 100-103

Dimensions and type material. Holotype; NHMW 2010/0036/0019, height 32.3 mm (Figs 100-103).

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

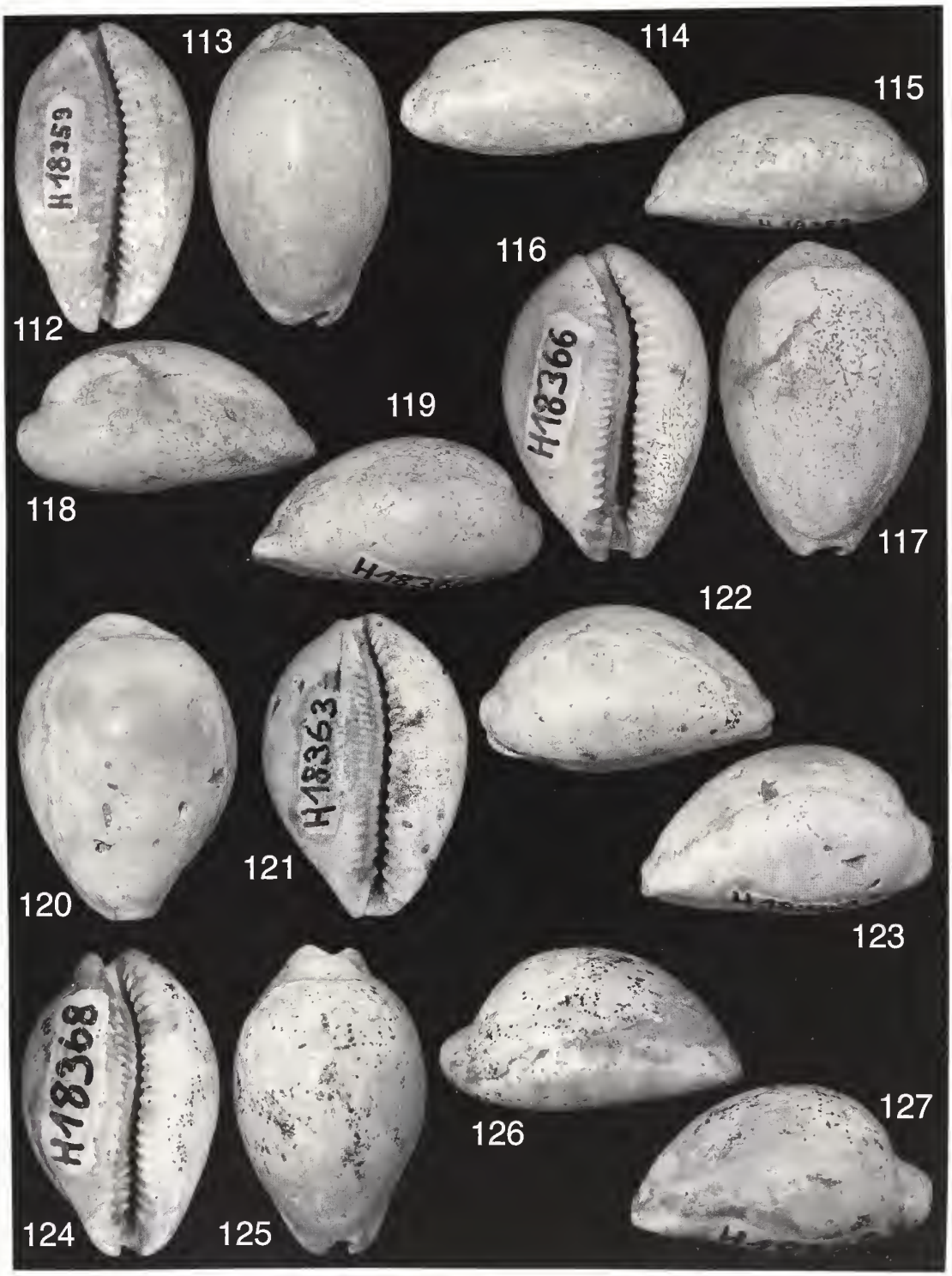
Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell of medium size and thickness for genus, inflated pyriform, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire weakly projecting, covered by adapical callus; sides rounded, moderately callused; ventrum flattened, convex in profile; aperture relatively wide and straight, posteriorly curving to the left, anterior portion much wider; siphonal canal narrow, abaxially asymmetrical; exhalant channel hardly produced, limited by parallel lips; Columella denticulate along entire length, bearing 19 sharp, narrow denticles, which extend as folds onto the columella peristome within the aperture, but not onto the ventrum with the exception of the three adapical denticles, which extend a short distance over the angulation onto the ventrum; terminal fold marginal, bordering the siphonal canal, where it is strengthened and keel-like, separated from the columellar teeth by a deep groove; fossula small, weakly concave, very steep, poorly delimited from the rest of the columella, bearing ridges which do not extend to the smooth inner edge; 20 very short, sharp labral teeth, developed at the inner edge, but not extending onto the labrum; labrum moderately thickened in the medial portion. A suggestion of a spotted marginal colour pattern and dorsal banding is preserved, this pattern enhanced under UV light.

Shell Formula. 32.3 (65.9 – 51.3) 18: 18

Figures 112-127

112-115. *Pseudozonaria primarobertsi* n. sp. Paratype 3 NMB H18359 (NMB coll.), length 28.9 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **116-119.** *Pseudozonaria primarobertsi* n. sp. Paratype 6 NMB H18366 (NMB coll.), length 24.8 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **120-123.** *Pseudozonaria primarobertsi* n. sp. Paratype 5 NMB H18363 (NMB coll.), length 25.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **124-127.** *Pseudozonaria falconensis* n. sp. Holotype NMB H18368 (NMB coll.), length 16.5 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón, State Venezuela.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H18359
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H18366
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H18363
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H18368
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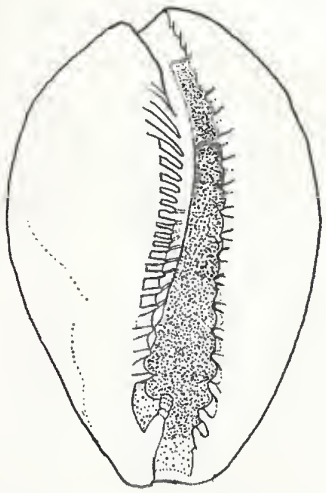
Specimen	collection number	length	width	height	LT	CT
Holotype (Figs 100-103)	NHMW 2010/0036/0019	32.3	21.3	16.6	20	19

Table 11. Dimensions and number of teeth; *Pseudozonaria praeaequinoctialis* n. sp.



Text-figure 10. *Pseudozonaria praeaequinoctialis* n. sp. Holotype NHMW 2010/0036/0019 (NHMW coll.; ex. BL coll.), length 32.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. *Pseudozonaria praeaequinoctialis* n. sp. is clearly the predecessor of the *Pseudozonaria annettae*-group now living in the tropical American Pacific. This group is characterised by their very short teeth and wide apertures. In the Recent faunas two species/subspecies are recognised, which we prefer to recognise at full species level, a northern form, *P. annettae* (Dall, 1909) found along the Pacific coast of Mexico, and a southern form *P. aequinoctialis* (Schilder, 1933) from Panama to Ecuador. The northern form is easily separated from *P. praeaequinoctialis* having a much more elongated-pyriform shell shape. The southern form differs from the northern form in having a heavier, broader shell with slightly coarser teeth, and therefore is closer to the fossil species. *Pseudozonaria praeaequinoctialis* differs from *P. aequinoctialis* in having an even broader shell (width/height 59.1 vs 65.9 in *P. praeaequinoctialis*) and in having considerably fewer columellar denticles (CT = 14 vs. 18 in *P. praeaequinoctialis*).

Zonaria frassinetti Groves & Nielsen, 2003 from the early late Miocene, Tortonian of Chile is here reassigned to the *Pseudozonaria annettae*-group characterised by its very wide aperture and widely spaced and sharp denticles. In *Pseudozonaria frassinetti* these features are exaggerated, so that it has the widest aperture of any of the group and the least number of teeth, especially on the columellar side where they are obsolete on the posterior portion of the columella (shell formula for *Z. frassinetti*; 28.1 (62.2 – 44.5) 13: 4).

Etymology. Combination of before = 'prae' and equinoctial = 'aequinoctialis'[Latin].

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

***Pseudozonaria primarobertsi* n. sp.**
Text-figure 11; Figs 104-123

Dimensions and type material. Holotype; NMB H18364, length 22.7 mm (Figs 104-107); paratype 1 NMB H18365, length, 21.3 mm (Figs 108-111); paratype 2 NMB H18367, length, 24.7 mm; paratype 3 NMB H18359, length, 28.9 mm (Figs 112-115); paratype 4 NMB H18361, length, 24.4 mm; paratype 5 NMB H18363, length, 25.3 mm (Figs 120-123); paratype 6 NMB H18366, length, 24.8 mm (Figs 116-119).

Other material. 20 specimens BL coll.

Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell small, solid, oval-depressed to cylindrical-pyriform, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire involute, covered by adapical callus; sides rounded, strongly to moderately callused, callus ascending to ⅓-½ shell height; ventrum flattened, very weakly convex at the extremities; aperture of medium width, parasigmoidal, posteriorly strongly curving to the left, anterior portion very slightly wider; siphonal canal narrow, abaxially asymmetrical; exhalant channel weakly produced, deep, limited by parallel lips; columella denticulate along entire length, bearing 16-22 coarse, elevated denticles, which extend as folds onto the columella peristome and a very short distance over the angulation onto the ventrum, anterior two columellar teeth larger and often fused or partially so; terminal fold strongly developed and elevated,

bordering the siphonal canal, where it is strengthened and keel-like with a prominent, elevated internal lamina (sensu Dolin & Lozouet, 2004), separated from the columellar teeth by a deep groove; fossula hardly developed and poorly delimited from the rest of the columella, very steep, bearing ridges which extend to the inner edge, ending in a denticle; 20-24 coarse labral teeth, outer lip bevelled inwards, with teeth extending across the bevelled inner portion and a short distance onto the labrum. A suggestion of a fine, messy spotted marginal colour pattern is preserved in some specimen, enhanced under UV light.

Shell Formula. 'cylindrical-pyriform morphotype'; 23.0 (65.8 – 51.7) 22: 18

Specimen	collection number	length	width	height	LT	CT
holotype (Figs 104-107)	NMB H18364	22,7	15,3	11,7	20	16
paratype 1 (Figs 108-111)	NMB H18365	21,3	13,9	11,1	21	19
paratype 2	NMB H18367	24,7	15,8	12,6	21	18
paratype 3 (Figs 112-115)	NMB H18359	28,9	17,7	13,1	22	18
BL coll. 1		29,2	18,5	14,3	23	17
BL coll. 2		20,7	14,4	11,4	21	19
BL coll. 3		25,1	16,3	13,1	20	18
BL coll. 4		18,8	12,3	9,8	22	18
BL coll. 5		21,4	14,1	11,2	20	16
BL coll. 6		21,7	13,9	10,9	21	18
BL coll. 7		22,6	15,2	11,9	23	18
BL coll. 8		20,1	14,5	11,5	22	18
BL coll. 9		21,9	15,6	12,1	20	18
BL coll. 10		22,7	14,4	11,8	21	16
BL coll. 11		23,3	15,2	11,9	20	17

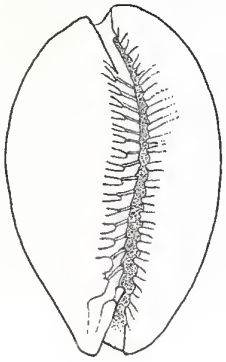
Table 12a. Dimensions and number of teeth; *Pseudozonaria primarobertsi* n. sp., 'cylindrical-pyriform morphotype'.

Shell Formula. 'oval-depressed morphotype'; 23.8 (71.1 – 54.0) 22: 20

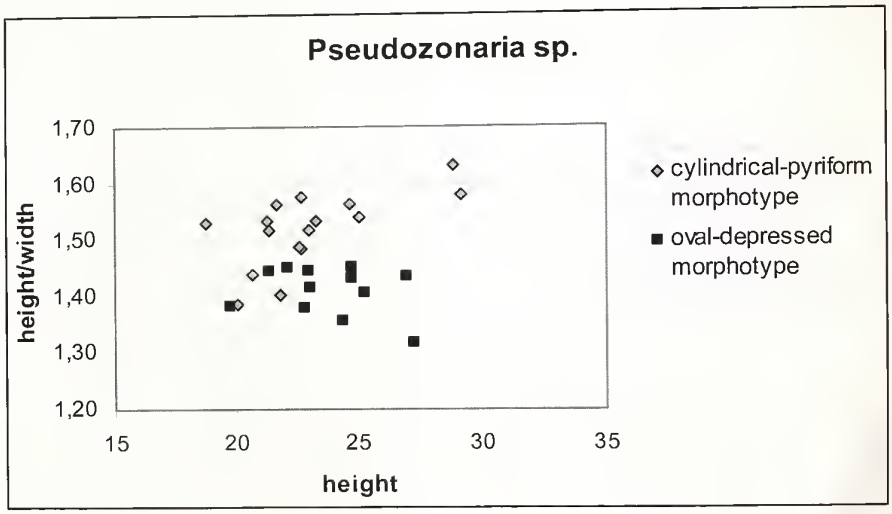
Specimen	collection number	length	width	height	LT	CT
paratype 4	NMB H18361	24,4	18	13,4	23	20
paratype 5 (Figs 120-123)	NMB H18363	25,3	18	14,2	21	22
paratype 6 (Figs 116-119)	NMB H18366	24,8	17,1	12,6	22	20
BL coll. 1		27,3	20,7	15,2	22	21
BL coll. 2		23,1	16,3	11,7	24	21
BL coll. 3		22,2	15,3	11,4	22	20
BL coll. 4		22,9	16,6	12,1	20	21
BL coll. 5		24,8	17,3	14	23	19
BL coll. 6		27	18,8	14,4	20	18
BL coll. 7		23	15,9	12,5	22	18
BL coll. 8		19,8	14,3	10,8	21	18
BL coll. 9		21,4	14,8	12	20	22

Table 12b. Dimensions and number of teeth; *Pseudozonaria primarobertsi* n. sp., 'oval-depressed morphotype'.

Text-figure 11 (opposite). *Pseudozonaria primarobertsi* n. sp.. Paratype 1 NMB H18365 (NMB coll.), length 21.3 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.



Discussion. *Pseudozonaria primarobertsi* n. sp. is the most common cypraeid in the Cantaure Formation. Two morphotypes occur; a 'cylindrical-pyriform morphotype' and an 'oval-depressed morphotype'. Apart from the difference in shell shape the 'oval-depressed morphotype' tends to have one or two more columellar teeth than the 'cylindrical-pyriform morphotype' and the teeth in general tend to be somewhat less coarse and elevated in the 'oval-depressed morphotype', however, the character of the strong terminal ridge, very weakly developed fossula and ridged columellar peristome is the same in both morphotypes. Moreover, a fair number of specimens could not be clearly ascribed to one or other morphotypes. The differences seen in the two morphotypes could indicate sexual dimorphism.

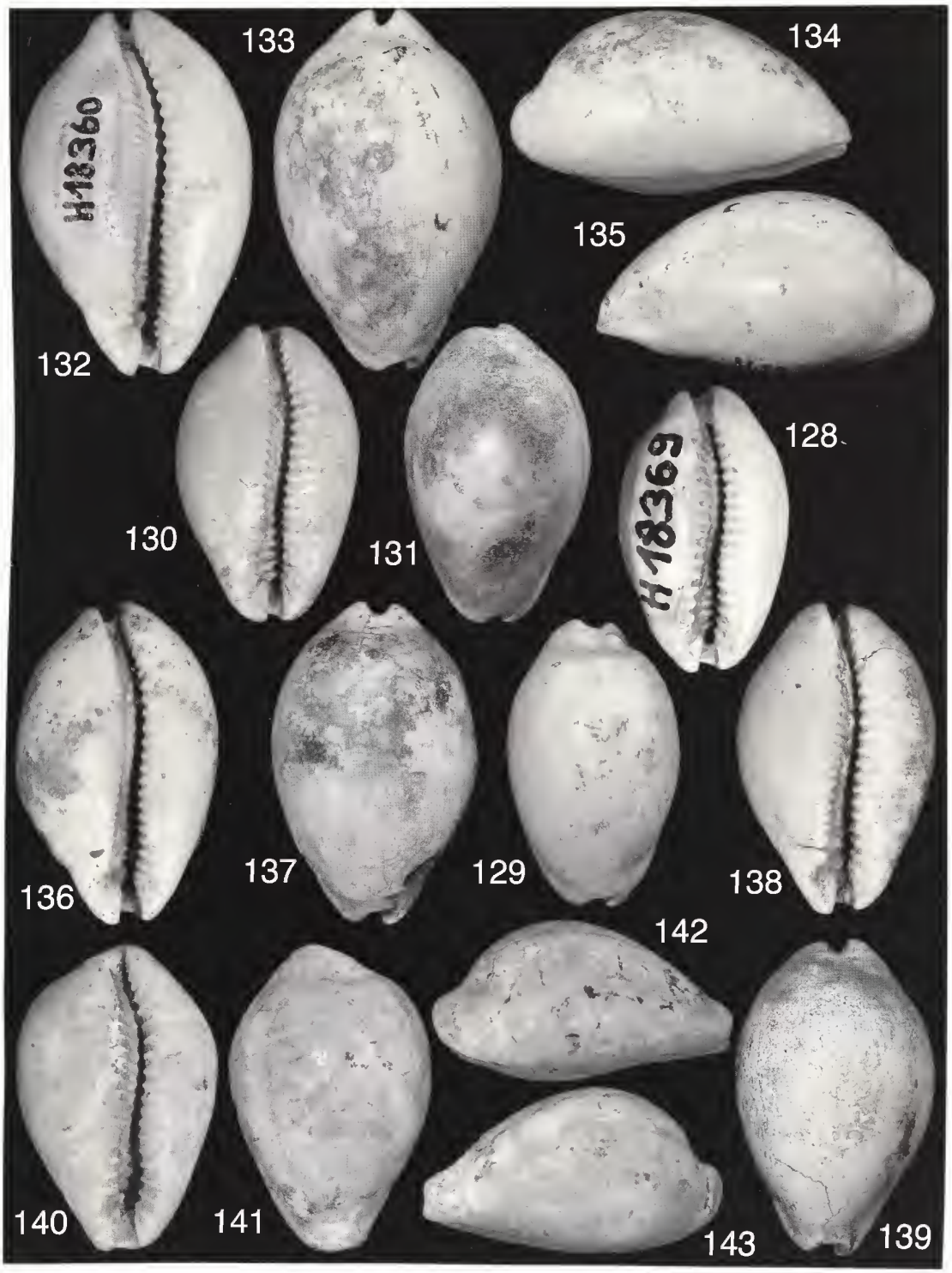


Text-figure 12. Height against height/width; *Pseudozonaria primarobertsi* n. sp.

Pseudozonaria primarobertsi n. sp. is clearly closely similar in size, shape and character of the teeth to the Recent tropical American *P. robertsi* (Hidalgo, 1906). As seen in our fossil taxon, the development of the marginal callus in *P. robertsi* is also somewhat variable The main difference between the two taxa is that the Recent species has fewer columellar teeth (CT = 12 vs 18-20 in *P. primarobertsi*).

Figures 128-143

128-129. *Pseudozonaria falconensis* n. sp. Paratype 1 NMB H18369 (NMB coll.), length 14.4 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **130-131.** *Pseudozonaria falconensis* n. sp. Paratype 2 NHMW 2010/0036/0020 (NMMW; ex. BL coll.), length 16.7 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela; **132-135.** *Zonaria pseudotumulus* n. sp. Holotype NMB H18360 (NMB coll.), length 27.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela;
136-137. *Zonaria pseudotumulus* n. sp. Paratype 1 NHMW 2010/0036/0022 (NMMW; ex. BL coll.), length 26.4 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela. **138-139.** *Zonaria pseudotumulus* n. sp. Paratype 2 NHMW 2010/0036/0023 (NMMW; ex. BL coll.), length 22.2 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela;
140-143. *Zonaria spurcoides* (Gabb, 1873) NHMW 2010/0036/0031 (NMMW; ex. BL coll.), length 28.3 mm. Baitoa Formation, early Miocene, Arroyo Hondo, Yaque del Norte River, Dominican Republic.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In the Neogene several species have been described with shells closely similar to those of *P. robertsi*. Olsson (1964) described *P. telembiensis* from the Pacific portion of the Neogene Gatunian Province, from a single specimen from the late Miocene Angostura Formation of Ecuador. Groves (1997) re-illustrated the holotype. This Ecuadorian species is extremely similar in shape to *P. primarobertsi*, differing only in the less crowded nature of the teeth (shell formula for *P. telembiensis*; 19.7 (67-52) 16: 15). Groves (1997) described *Zonaria cathyae* from the early Pliocene Esmeraldas beds of the Onzole Formation of Ecuador. Now considered a *Pseudozonaria,* it is extremely similar to the 'oval-depressed morphotype' of *P. primarobertsi*, and indeed, apart from slightly fewer teeth in *P. cathyae*, their shell formulae are very similar (shell formula for *P. telembiensis*; 22.3 (71-57) 19: 17). The main difference between the two taxa is in the apertural characteristics of the anterior portion. In all members of the *P. robertsi*-group, including *P. primarobertsi*, *P. portelli* Petuch, 1990, *P, raymondrobertsi* (Pilsbry, 1922) (holotype; Figs 169-172), *P. telembiensis* and *P. fehsei* Landau & Silva, 2010 (holotype; Figs 165-168) the terminal ridge is strong and keel-like followed by a deep groove separating the most anterior columellar tooth, which is usually more strongly developed. *Pseudozonaria cathyae* does not belong to this group, having the anterior third of the aperture dilated by a small hemispherical expansion, and there is no deep groove separating a weaker terminal ridge from the relatively fine columellar teeth.

Pseudozonaria raymondrobertsi, from the early Pliocene Gurabo Formation of the Dominican Republic and early Pliocene Bowden Formation of Jamaica, can be easily separated by the consistently well developed and angular marginal callus giving the shell a very broad, depressed shape. *Pseudozonaria raymondrobertsi* differs from the rest of the *P. robertsi*-group in usually having the terminal ridge less strongly developed, the groove between the terminal ridge and first columellar tooth shallower (although it is quite prominent in the holotype Figs 104-107) and in having fewer, finer, longer teeth (shell formula for *P. raymondrobertsi*; 28.2 (70.5-51.1) 16: 14: ten specimens from Arroyo Zamba, Dominican Republic, BL coll.).

Pseudozonaria fehsei from the early Pliocene Cubagua Formation of Cubagua Island, Venezuela also has a similar shell shape, but differs in the nature of the aperture, which is a little wider in the anterior portion in *P. fehsei* and the teeth are a little longer and, especially on the labial side, are a little more widely spaced (shell formula for *P. fehsei*; 24.7 (66-50.6) 18: 16). *Pseudozonaria portelli* from the Pleistocene Bermont Formation of Florida has very coarse denticles (shell formula for *P. portelli*; 25 (63.9-51.5) 19: 15), similar in number to *P. fehsei* and *P. telembiensis*, but differs in that the columellar denticles do not extend over the columellar peristome (see Petuch, 1990, fig. 9).

Etymology. Reflecting the earliest species in the *P. robertsi* species-group known.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

Figures 144-172 (type specimens of some tropical American Neogene Cypraeidae).

144-145. *Muracypraea henekeni* (G. B. Sowerby I, 1850) Lectotype BMNH G83940, length, 58 mm, Miocene, Yaque River, St. Domingo. Colld. Col. T.S. Heneken, ('J.S. Heniker'), c. 1848; **146.** *Luria patrespatriae* (Maury, 1917) Holotype PRI 28780 (ex Gabb collection), length 27.9 mm. Bluff 1, Cercado de Mao, Santo Domingo (specimen figured by Maury, 1917, pl. 19, fig. 10; adapical portion of outer lip seems to have been damaged since the original figure was taken). Image courtesy of the Paleontological Research Institution; **147-150.** *Pustularia (Pustularia) americana* Schilder, 1939 Holotype NMB H 11259, length 11.2 mm, width 7.8 mm, height 6.2 mm, Lower Miocene?: Cauto Fluss, road from Alto Cedro to Palma Soriano, Cuba; **151-154.** *Propustularia caribaea* (Schilder, 1939) Holotype NMB H11260, length 13.6 mm, width 9.0 mm, height 6.8 mm, early Middle Miocene Grand Bay Formation, Carriacou; **155-156.** *Propustularia bartschi* (Ingram, 1939) Holotype USNM 559684, length 25.8 mm, width, 17 mm, height 12.8 mm, Lower Pleistocene, Moin Formation, Limon, Costa Rica; **157-158.** *Zonaria pittorum* Groves, 1997 Holotype LACMIP 12432, length 40.1 mm, width 20.9 mm, height 12.8 mm, Lower Pliocene, TU locality 1399, roadcut on west side of village of Camarones, 20 km east of bridge over Rio Esmeraldas, Esmeraldas Beds, Onzole Formation, Ecuador; **159-160.** *Pseudozonaria frassinetti* (Groves & Nielsen, 2003) Hypotype LACMIP 13720, length 23.1 mm, width, 14.8 mm, height, 11.2 mm, early Upper Miocene, Tortonian, Navidad Formation, tidal platform approximately 1 km north of Matanzas, Cardenal Caro Province, central Chile; **161-164.** *Zonaria spurcoides* (Gabb, 1873) Lectotype ANSP 2999, length 32.5 mm, 20.5 mm, height, 16.5 mm, Miocene, Santo Domingo; **165-168.** *Pseudozonaria fehsei* Landau & Silva, 2010 Holotype NHMW 2010/0038/0013 (NHMW coll., ex BL coll.), Lower Pliocene, Araya Formation, Cañon de las Calderas, Cubagua Island. Length 26.6 mm, width 16.9 mm; **169-172.** *Pseudozonaria raymondrobertsi* (Pilsbry, 1922) Holotype ANSP 3995, length 275 mm, 19 mm, height, 15 mm, Miocene, Santo Domingo.

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Pseudozonaria falconensis n. sp.
Text-figure 13; Figs 124-131

Dimensions and type material. Holotype; NMB H18368, height 16.5 mm (Figs 124-127); paratype 1 NMB H18369, height 14.4 mm (Figs 128-129); paratype 2 NHMW 2010/0036/0020, height, 16.7 mm (Figs 130-131); paratype 3 NHMW 2010/0036/0021, height, 14.9 mm.

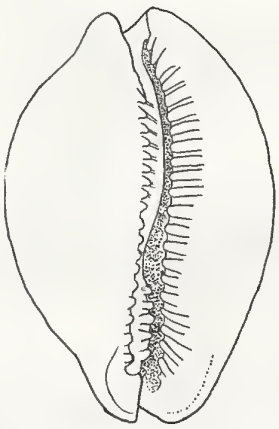
Type locality. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón State, Venezuela (=locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Type stratum. Cantaure Formation (early Miocene: Burdigalian).

Description. Shell very small, solid, cylindrical-pyriform, posteriorly swollen, in lateral profile dorsal curvature regularly attenuated abapically, spire involute to very weakly projecting, covered by adapical callus; sides rounded, moderately callused, callus ascending to ⅓-½ shell height; ventrum weakly convex in profile; aperture of medium width, almost straight, posteriorly weakly curving to the left, anterior portion very slightly wider; siphonal canal narrow, abaxially asymmetrical; exhalant channel moderately produced, widening slightly adapically; columella denticulate along entire length, bearing 15-21 short, coarse denticles, which extend as folds a short distance onto the columella peristome, but not across the angulation onto the ventrum, anterior columellar teeth slightly more prominent; inner ⅔ of columella peristome smooth; terminal fold strongly developed and elevated, bordering the siphonal canal, where it is strengthened and keel-like with a prominent, elevated internal lamina (sensu Dolin & Lozouet, 2004), separated from the columellar teeth by a groove; fossula relatively well developed, concave, but poorly delimited from the rest of the columella, very steep, bearing five ridges of variable strength extending from the anterior columellar teeth to the inner edge of the fossula, where they form relatively long, extremely large, rounded inner teeth; 19-24 coarse labral teeth, anterior third of labral teeth stretched out on slightly constricted, depressed, hemicircular area; outer lip bevelled inwards, with teeth extending across the bevelled inner portion and a variable distance onto the labrum, at most just short of mid-labrum. No colour pattern preserved.
Shell Formula. 14.3 (64.5 – 52.2) 26: 20

specimen	collection number	length	width	height	LT	CT
holotype (Figs 124-127)	NMB H18368	16,5	10,5	8,6	21	19
paratype 1 (Figs 128-129)	NMB H18369	14,4	8,9	7,3	21	15
paratype 2 (Figs 130-131)	NHMW 2010/0036/0020	16,7	10,7	8,5	24	21
paratype 3	NHMW 2010/0036/0021	14,9	9,7	7,9	21	18
BL coll. 3		11,2	7,6	6,2	19	13

Table 13. Dimensions and number of teeth; *Pseudozonaria falconensis* n. sp.



Text-figure 13. *Pseudozonaria falconensis* n. sp. Holotype NMB H18368 (NMB coll.), length 16.5 mm. lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Paraguaná Peninsula, Falcón State, Venezuela.

Discussion. This is the smallest *Pseudozonaria* species in the Cantaure Formation, and easily recognised by its rather produced posterior extremity and relatively well developed fossula, which is smooth in the middle, but with enormous teeth developed at the inner edge of the fossula. We have not found any congener with this feature similarly strongly developed.

Etymology. Named for Falcón State, Venezuela.

Geological and geographical distribution.

Lower Miocene: Cantaure Formation, Venezuela.

BIOGEOGRAPHIC IMPLICATIONS

The southern Caribbean early Miocene had a rich and varied cypraeid assemblage, with thirteen species here recorded from the early Miocene, Burdigalian assemblage of Cantaure, ten of which are described as new. The presence of an equally rich cypraeid assemblage in the early Miocene of the Chipola Formation, northern Florida, was described by Dolin (1991). As mentioned in the introduction, cypraeids are a difficult group to work with, and both the specific and supraspecific classification varies

enormously between researchers. In order for us to compare the faunas on either side of the Caribbean early Neogene we must first review the classification offered by Dolin (1991). Table 14 presents a generic revision of Dolin's (1991) taxa. This is not a species-level revision, which is beyond the scope of this work, and some of the taxa may well be junior subjective synonyms (see Fehse, 2004).

Classification fide Dolin (1991)	Current taxonomy
Cypraeorbis emilyae n.sp.	*Cypraeorbis emilyae* (Dolin, 1991)
Cypraeorbis hertleini (Ingram, 1948)	*Cypraeorbis willcoxi willcoxi* (Dall, 1890)
Cypraeorbis ballista (Dall, 1915)	*Cypraeorbis willcoxi ballista* (Dall, 1915)
Zoila willcoxi (Dall, 1890)	*Cypraeorbis willcoxi willcoxi* (Dall, 1890)
Zoila arlettae n.sp.	*Cypraeorbis arlettae* (Dolin, 1991)
Siphocypraea chilona (Dall, 1900)	*Cypraeorbis chilona* (Dall, 1900)
Trona leporina calhounensis n.ssp.	*Trona calhounensis* Dolin, 1991
Talparia dominiciensis (Gabb, 1873) [of Dolin, 1991]	*Luria dominiciensis* (Gabb, 1873) [of Dolin, 1991] = *L. dockeryi* (Dolin & Lozouet, 2004)
Talparia mariaelisabethae n.sp	*Luria mariaelisabethae* (Dolin, 1991)
Mauritia campbelliana (Pilsbry, 1922)	*Luria campbelliana* (Pilsbry, 1922)
Lyncina theresae n.sp.	*Zonaria theresae* (Dolin, 1991) [?= *Z. mariaelisabethae* (Dolin, 1991)]
Erronea (Adusta) tumulus (Heilprin, 1886)	*Zonaria tumulus* (Heilprin, 1886)
Erronea (Adusta) heilprinii (Dall, 1890)	*Zonaria heilprinii* (Dall, 1890)
Erronea (Adusta) spurcoides (Gabb, 1873)	*Zonaria spurcoides* (Gabb, 1873)
Erronea (Adusta) shirleyae n.sp.	*Zonaria shirleyae* (Dolin, 1991)
Bistolida praelatior n.sp.	*Zonaria praelatior* (Dolin, 1991)

Table 14. Cypraeid assemblage present in the early Miocene Chipola Formation of northern Florida; classification of Dolin (1991) vs. current taxonomy.

From a palaeobiogeographic perspective the Cantaure Formation assemblage is chronologically the oldest Neogene deposit, situated geographically on the southernmost part of the Gatunian palaeobiogeographic province (Vermeij & Petuch, 1986; Vermeij, 2005; Landau et al., 2008). The Chipola Formation assemblage is situated geographically within the neighbouring northern Caloosahatchian Province, which was already a distinct palaeobiogeographic province by the early Miocene (Vermeij, 2005). In the present work we identify two genera, *Muracypraea* and *Propustularia*, which seem to be endemic to the Gatunian Province. *Pseudozonaria* has not been found in the Caloosahatchian Province during the Miocene or Pliocene, but is represented by a single, extremely rare species in the Pleistocene, *P. portelli* (Petuch, 1990). Conversely, *Cypraeorbis* Conrad, 1865 has not so far been recorded in the Neogene Gatunian Province.

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Description of two new *Favartia* species (Gastropoda: Muricidae: Muricopsinae) from Masirah Island, Oman, Arabian Peninsula

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KEYWORDS. Eastern Indian Ocean, Arabian Peninsula, Oman, Gastropoda, Muricidae, *Favartia* n. sp.

ABSTRACT. Two new species of Muricidae are described and compared with similar looking species from the western Indian Ocean. The *Favartia* species from the studied area are all illustrated.

INTRODUCTION

There are currently 64 known Recent species of *Favartia* s.s. and 22 of *Favartia (Pygmaepterys)* (sensu Houart, in litt.). Twenty-five of these species occur in the Indian Ocean of which 12 are also recorded in the western Indian Ocean and 8 in the studied area, more precisely, Oman and nearby areas: *Favartia (Favartia) cecalupoi* Bozzetti, 1993, *F. (F.) cyclostoma* (Sowerby, 1841), *F. (F.) deynzeri* Houart, 1998, *F. (F.) flexirostris* (Melvill, 1898), *F. (F.) marjoriae* (Melvill & Standen, 1903), *F. (Pygmaepterys) adenensis* (Houart & Wranik, 1989), *F. (P.) paulboschi* Smythe & Houart, 1984 and *F. (P.) yemenensis* (Houart & Wranik, 1989).

The Mollusca of this part of the world were recently commented on and illustrated in several publications and books. The first publication, by Biggs (1973), includes Mollusca of the Trucial Coast, at the southern end of the Persian Gulf (United Arabs Emirates), but only a few muricids were listed and one was illustrated: *Hexaplex kusteriamus* (Tapparone-Canefri, 1875). Doreen Sharabati (1981) followed with a fully illustrated volume with over 100 species of mollusks depicting their habitats, their uses by man throughout the years and illustrating many species in their habitat. In 1982, Kathleen Smythe published a small book about the seashells of the Arabian Gulf, but only a few species were illustrated. Still in 1982 and then in 1989, Donald and Eloise Bosch published two very useful books devoted to the seashells of Oman and of Southern Arabia with numerous color illustrations of the shells. Then more recently, a team of specialists, well known for their many contributions to the study of mollusks, Donald T. Bosch, S. Peter Dance, Robert G. Moolenbeek and P. Graham Oliver (1995) published a huge and impressive book where more than a thousand species were described and illustrated.

Three *Favartia* species were illustrated by these authors: *F. (F.) cyclostoma* (Sowerby, 1841) (Bosch et al., 1995: 119, fig. 470), *F. marjoriae* (Melvill & Standen, 1903) (Bosch et al., 1995: 119, fig. 472), *F. (P.) paulboschi* Smythe & Houart, 1984 (Bosch & Bosch, 1989: 58; Bosch et al., 1995: 119, fig. 472) and *F. (P.) colombi* n. sp. [under the name *F. (P.) yemenensis*] (Bosch et al., 1995: 120, fig. 478).

Favartia marjoriae (Melvill & Standen, 1903) (Figs 23-25) is probably conspecific with *F. (F.) maculata* (Reeve, 1845) (Fig. 26), a species living throughout the Indo-West Pacific and known to have very variable shell characters. The protoconch of *F. marjoriae* has not yet been examined, but this and eventually DNA studies of *F. marjoriae* and of different forms of *F. maculata* will be necessary to confirm or refute their conspecificity.

Table 1. Terminology used to describe the spiral cords and apertural denticles (after Merle, 1999 and 2001) Terminology in parentheses: erratic feature.

P :	Primary cord
s :	secondary cord
IP :	Infrasutural primary cord (primary cord on subsutural ramp)
adis :	adapical infrasutural secondary cord (on subsutural ramp)
abis :	abapical infrasutural secondary cord (on subsutural ramp)
P1 :	Shoulder cord
P2-P6 :	Primary cords of the convex part of the teleoconch whorl
s1-s6 :	secondary cords of the convex part of the teleoconch whorl
example: s1 = secondary cord between P1 and P2; s2 = secondary cord between P2 and P3, etc.	
ADP :	adapertural primary cord on the siphonal canal
MP :	median primary cord on the siphonal canal
ABP :	abapertural primary cord on the siphonal canal
ads :	adapertural secondary cord on the siphonal canal
ms :	median secondary cord on the siphonal canal
abs :	abapertural secondary cord on the siphonal canal
eabs :	extreme abapertural secondary cord on the siphonal canal
Example: eabs1 = secondary cord between EABP and EABP1	
APERTURE	
ID:	Infrasutural denticle
D1 to D6:	Abapical denticles

Abbreviations

BMNH: Natural History Museum, London, U.K.
IRSNB: Institut royal des Sciences naturelles de Belgique, Bruxelles, Belgium.
MNHN: Muséum national d'Histoire naturelle, Paris, France.
JC: Collection of Jacques Colomb, Marseille, France.
RH: Collection of Roland Houart.
SG: Collection of Sando Gori.

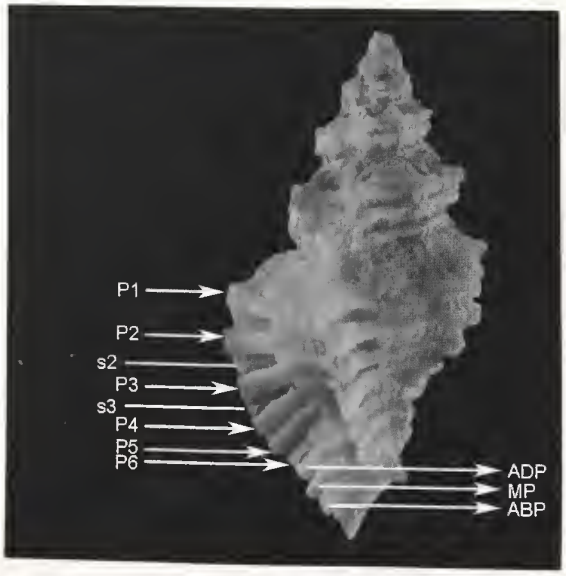


Figure 1. Terminology of the spiral sculpture morphology in *Favartia colombi* n. sp.

SYSTEMATICS

Family **MURICIDAE** Rafinesque, 1815
Subfamily **MURICOPSINAE** Radwin & D'Attilio, 1971
Genus ***Favartia*** Jousseaume, 1880
Type species by original designation: *Murex breviculus* Sowerby, 1834, Recent, Indo-West Pacific.

Favartia (Favartia) colombi n. sp.
Figs 1, 2-6, 27

Pygmaepterys yemenensis – Bosch et al. 1995: 120, fig. 478.

Type material. Oman, Masirah Island, Ras Al Ya, 20°29'42" N, 58°57'029" E, 21 m, on coarse sand, holotype IRSNB IG 31676/ MT 2316.
Paratypes: Oman, Masirah Island, Ras Al Ya, 20°29'42" N, 58°57'029" E, 21 m, on coarse sand, 1 MNHN 23206; Sur Masirah, east of Masirah Island, 1 m, low tide, under stones, 1 BMNH 20100521; Oman, Masirah Island, Ras Al Ya, 20°39'504" N, 58°52'138" E, 21 m, on sand 4 RH, 7 SG; Masirah Island, 2 m, 1 JC, 1 RH.

Other material examined. Oman, Masirah Island, Ras Al Ya, 20°32'895" N, 58°57'420" E, 13 m, on sand (8 SG, 2 RH); Masirah Island (3 JC); Masirah Island, 2 m (2 JC); Sur Masirah, east of Masirah, 1 m, low tide, under stones (15 JC); North of Muscat, Mina al Fahl, 24-30 m, dredged, sand and mud (4 RH).

Distribution. Oman, north of Muscat and Masirah Island.

Description. Shell medium-sized for the genus, up to 16.5 mm in height at maturity. Height/width ratio 1.63-1.93:1. Slender, lanceolate, shoulder weakly sloping, weakly concave.
Greyish-white or tan with lighter colored primary spiral cords. Aperture light brown within.
Spire high with 1.6 protoconch whorls and teleoconch up to 5 weakly angular, strongly shouldered whorls. Suture impressed, partially obscured by third primary spiral cord (P3) of previous whorl. Protoconch small. Whorls with a single strong but narrow adapical keel. Terminal lip thin, erect, weakly curved.
Axial sculpture of teleoconch whorls consisting of prominent, narrow varices, each with short, scabrous, open spinelets decreasing in strength and length abapically, connected to each other with scabrous flange. Nine varices from first to third teleoconch whorl, decreasing to 6-8 on fourth whorl and 4 or 5 on last whorl. Spiral sculpture of high, strong, narrow, smooth primary cords and occasionally very narrow secondary cords. First and second whorls with visible P1 and P2 or P1-P3. Third and fourth whorls of juvenile specimens with P1, P2, s2, P3, P4, P5, P6, ADP and MP. Fifth whorl with P1, (s1), P2, s2, P3, (s3), P4, P5, s5, P6, (s6), ADP, MP, ABP. Shoulder ramp smooth except for axial varices. P1-P4 almost similar in size and strength, P4 and P5 close to each other, P5 weakly narrower, P6 narrower spiral cord, almost half the size of P1-P4; ADP and MP broad. Primary cords more obvious on adapertural part of varices. Secondary cords very narrow, only obvious on varices.
Aperture moderately small, ovate. Columellar lip narrow, smooth, rim partially erect at abapical extremity, otherwise adherent. Anal notch shallow, broad. Outer lip weakly erect, weakly crenulated, with weak, elongate denticles within: ID, D1 or D1 split, D2 split, D3 split, D4 and D5. ID very low, D1 low, D2-D5 increasing in strength abapically. Siphonal canal short, 23-29% of total shell height, narrow, weakly dorsally recurved at tip, narrowly open, with 2 or 3 short scabrous spines originating from ADP, MP and ABP. ADP broadest.
Operculum and radula unknown.

Remarks. Other *Favartia* s.s. species occur in the western Indian Ocean, mostly along the East African coast, up to Somalia and the Red Sea. The species most similar to *F. colombi* n. sp. are *Favartia (Favartia) cecalupoi* Bozzetti, 1993, *F. cyclostoma* (Sowerby, 1841), *F. nucula* (Reeve, 1845), *F. peasei* (Tryon, 1880), *F. rosamiae* D'Attilio & Myers, 1985 and *F. sykesi* (Preston, 1904).

Favartia cecalupoi (Fig. 13) from Somalia differs in many respects i.e. the protoconch which consists of 2 smooth bulbous whorls. The shell is more rounded with a broader last teleoconch whorl, the varices are lower and the spiral cords are more numerous. *F. cyclostoma* is larger relative to the number of teleoconch whorls, the shell is also much broader with a rounded paucispiral protoconch of 1.5 whorls. *F. nucula*, *F. rosamiae*, *F. peasei* and *F. sykesi* differ in many respects such as breadth and height of the shell, axial and spiral sculpture and mainly by having different protoconch whorls, small, rounded and paucispiral in *F. nucula* and *F. peasei*, conical and multispiral in *F. rosamiae* (Figs 14, 32) and *F. sykesi*.

Favartia (Pygmaepterys) paulboschi Smythe & Houart, 1984 (Figs 15-16, 28), another *Favartia* species from Oman differs in having a relatively narrower shell *vs* its height, broader and flat primary spiral cords, fewer or absence of secondary cords, narrower varices with more adapically recurved shoulder spine, and relatively shorter and broader siphonal canal.

Favartia (F.) colombi was also confused with, and wrongly identified as *F. (P.) yemenensis* Houart & Wranik, 1989 (Figs 17-18, 29) (Houart, in litt.) which also has a keeled protoconch, and therefore was also illustrated as *Pygmaepterys yemenensis* in Bosch et al. (1995: 120). However, *F. yemenensis* differs from *F. colombi* n. sp. in having a more angular and broader shell with higher and narrower varices, in having a comparatively broader aperture, a longer siphonal canal and more numerous secondary spiral cords.

Favartia (Pygmaepterys) adenensis (Fig. 19) also occur in this area but is very different and does not need to be compared here.

Etymology. *colombi*: Named after Jacques Colomb (Marseille, France) who collected several specimens of the new species in Masirah, together with the junior author.

Favartia (Favartia) roseotincta n.sp.
Figs 7-12, 30

Type material. Oman, Masirah, Ras Al Ya, 20°39'504" N, 58°52'138" E, 21 m, on sand, holotype MNHN 23205
Paratypes: 3 RH, 3 SG.

Distribution. Oman, Masirah Island.

Description. Shell small for the genus, up to 8.3 mm in length at maturity. Height/width ratio 1.66 – 1.86:1, biconical, narrow, weakly spinose. Shoulder strongly sloping, weakly convex.
Pinkish white or light pink, occasionally with white varices and white siphonal canal. Aperture pink within, surrounded with white on columellar lip outer rim and outer apertural lip.
Spire high with 1.5 protoconch whorls and teleoconch up to 5 weakly convex, angular, strongly shouldered whorls. Suture impressed. Protoconch small, elongate, whorls rounded, last whorl strongly elongate. Terminal lip eroded.

Axial sculpture of teleoconch whorls consisting of high, strong, narrow varices, each with short, broad, blunt, open primary spines. First whorl with 8 varices, second to fourth with 8 or 9 varices, last whorl with 4 varices. Varices of last whorl broader and more distant from each other than in other whorls, with a large gap between third and fourth (apertural) varices, almost twice the distance between second and third varices. Spiral cords from first to penultimate teleoconch whorl of high, narrow, smooth primary cords. First and second whorls with visible P1 and P2, or P1-P3, P3 partially covered with next whorl, third and fourth whorl with visible P1-P3, P3 still partially covered by next whorl. Last whorl with IP, P1-P5, (s5), P6, (s6), ADP, MP. IP only weakly visible on axial varices, P1-P3 almost of same strength, P3 occasionally narrower, P4-P6 decreasing in strength abapically, P4 and P5 high, broad, P6 very small, almost obsolete, occasionally preceded by almost obsolete s5.
Aperture small, ovate, columellar lip narrow, smooth, lip partially erect, adherent on shell at 30-40% of adapical extremity. Anal notch moderately broad. Outer lip erect, with weak elongate, narrow denticles within: ID (split), D1 split, D2 (split), D3, D4, D5. Siphonal canal short, narrow, strongly dorsally recurved at tip, narrowly open, with ADP and MP giving rise to short, open, blunt spines.
Operculum and radula unknown.

Remarks. A few species of *Favartia* have an elongate and narrow shell such as observed in *F. roseotincta* n. sp., namely *F. flexirostris* (Melvill, 1898), *F. guamensis* Emerson & D'Attilio, 1979, *F. iredalei* Ponder, 1972, *F. jeanae* Bertsch & D'Attilio, 1980 and *F. peregrina* (Olivera, 1980).

Favartia flexirostris (Figs 20, 31) which also occurs in Oman, differs from *F. roseotincta* n. sp. by many shell characters, namely in having a rounded, globose protoconch (Fig. 31), more rounded teleoconch whorls with a globose last whorl and a rounded aperture, numerous, broad, secondary spiral cords on the whole shell, and a longer, more strongly tapered siphonal canal.

Favartia guamensis differs also in many ways, namely by having a very different, conical protoconch of sinusigeral type, consisting of 3-3.5 whorls, denoting planktotrophic larval development. Its geographical distribution is therefore also much more expanded, ranging from off Mozambique (East Africa) to the Tuamotus (Central Pacific). Other differences are numerous such as the lower and broader spire whorls, the narrower and straighter shoulder ramp, the broader and more squamous primary spiral cords, the small, rounded aperture with a characteristic narrow, deep anal notch and the single spine (ADP) on the narrower siphonal canal.

Favartia iredalei (Fig. 21) from Lord Howe Island, NSW, Australia and West Sumatra also has a different protoconch of 1.5 rounded whorls. It differs also in having a less sloping and narrower shoulder ramp with IP, or adis and IP, and in having more squamous primary cords and obvious secondary cords on the convex part of the last telcoconch whorl.

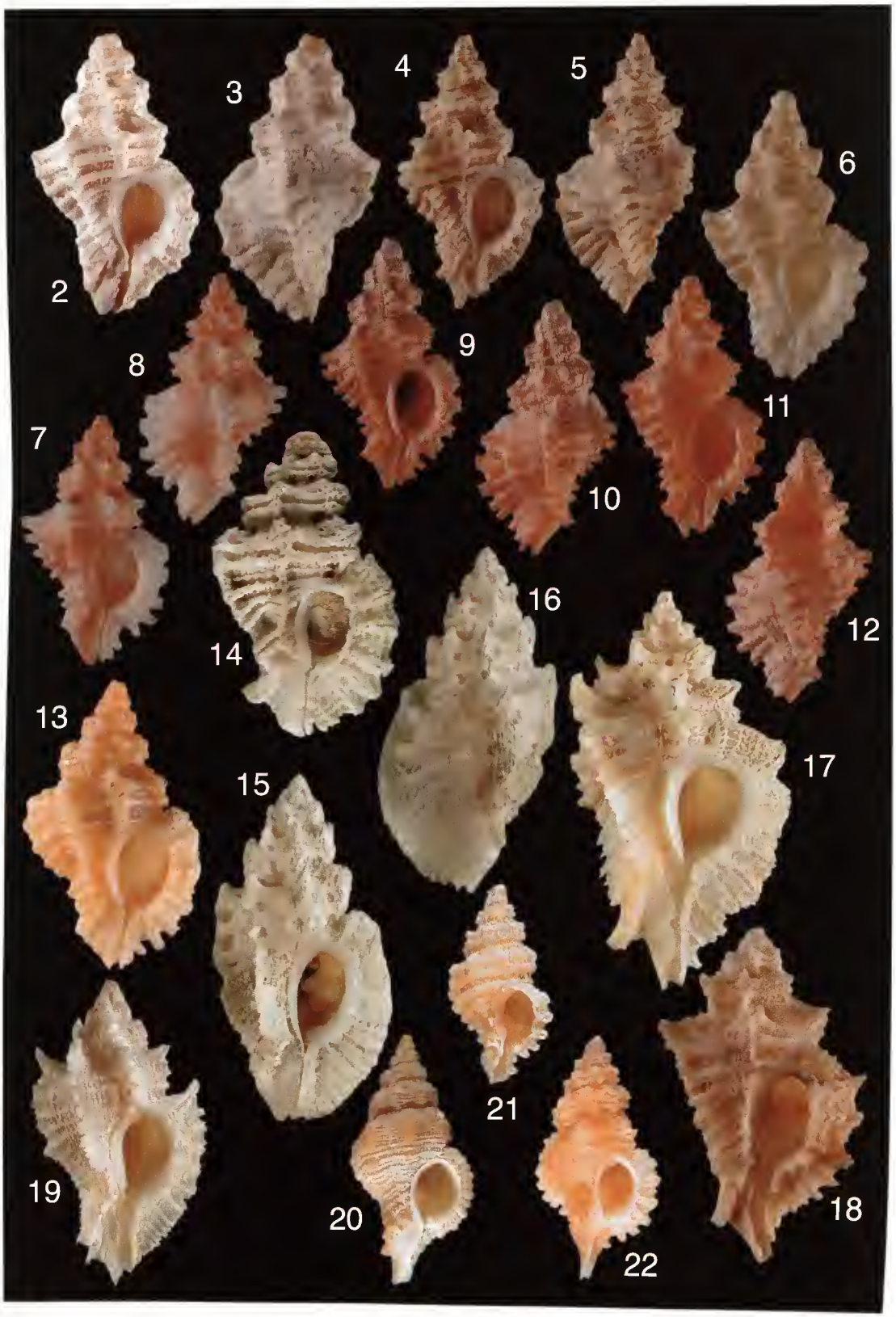
Both *F. jeanae* and *F. peregrina* from the Philippines also differ in having a different larval development, denoted by their conical, multispiral protoconch of 3-3.5 whorls and a terminal lip of sinusigeral type. The shell morphology of *F. jeanae* is close to *F. roseotincta* n.sp but besides the protoconch differences, the shell differs in having a comparatively higher spire, narrower primary spiral cords, obvious adis and IP on the shoulder ramp, and a narrower, tapered siphonal canal.

Favartia peregrina differs in many ways and does not need to be compared further here.

Another species from Elat (Red Sea), was named *Favartia elatensis* Emerson & D'Attilio, 1979 but it actually turned out to be a *Murexsul* species (Houart, 1994, Merle & Houart, 2003) and differs from *F. roseotincta* in many respects.

Figures 2-22

2-6. *Favartia (Favartia) colombi* n. sp.
2-3. Oman, Masirah Island, Ras Al Ya, 20°29'42" N, 58°57'029" E, 21 m, holotype IRSNB IG 31676/ MT 2316, 15.6 mm; **4-5.** Oman, Masirah Island, Ras Al Ya, 20°39'504" N, 58°52'138" E, 21 m, paratype RH, 12 mm; **6.** Oman, Masirah Island, Ras Al Ya, 20°29'42" N, 58°57'029" E, 21 m, paratype MNHN 23206
7-12. *Favartia (Favartia) roseotincta* n. sp., Oman, Masirah, Ras Al Ya, 20°39'504" N, 58°52'138" E, 21 m.
7-8. Holotype MNHN 23205, 8.3 mm; **9-10.** Paratype SG, 8.2 mm; **11-12.** Paratype RH, 8.1 mm.
13. *Favartia (F.) cecalupoi* Bozzetti, 1993, Ras Hafun, Somalia, SG, 12.4 mm; **14.** *Favartia (F.) rosamiae* D'Attilio & Myers, 1985, Seychelles, RH, 15.6 mm; **15-16.** *Favartia (F.) paulboschi* Smythe & Houart, 1984, Dhuwwah, Masirah, Oman, paratype RH, 17 mm; **17-18.** *Favartia (Pygmaepterys) yemenensis* (Houart & Wranik, 1989); **17.** Gulf of Aden, RH, 23 mm; **18.** Oman, Masirah Island, Ras Al Ya, SG, 16.7 mm; **19.** *Favartia (P.) adenensis* (Houart & Wranik, 1989), Gulf Of. Aden, PDR Yemen, paratype RH, 15.4 mm; **20.** *Favartia (F.) flexirostris* (Melvill, 1898), Oman, N Of. Muscat, RH, 11.3 mm; **21.** *Favartia (F.) iredalei* Ponder, 1972, Australia, NSW, Lord Howe Island, RH, 6.1 mm; **22.** *Favartia (F.) jeanae* Bertsch & D'Attilio, 1980, Philippines, Cebu, RH, 8.5mm.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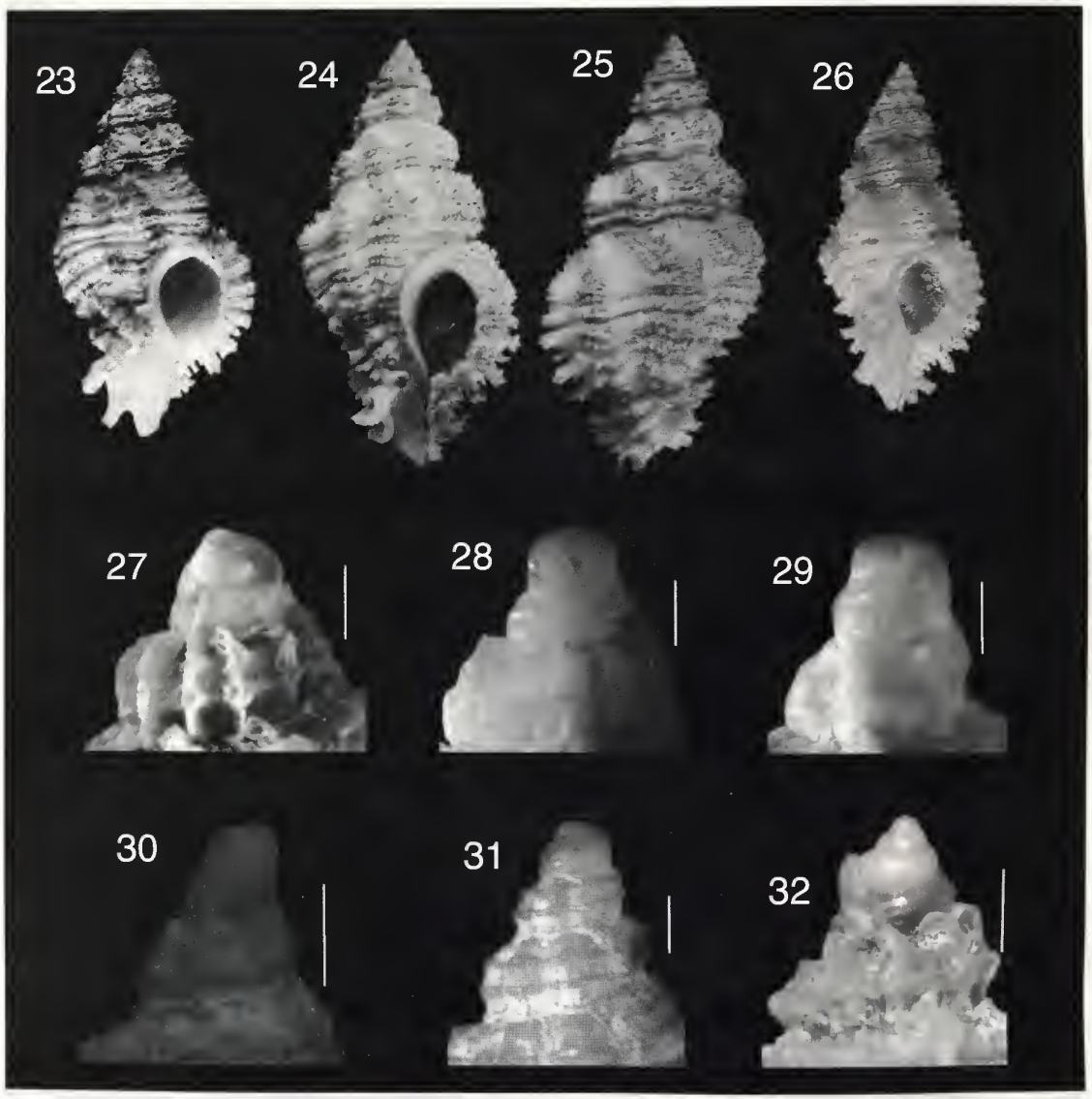
Favartia colombi n.sp. described above as occurring in the same area differs in being larger with a similar number of teleoconch whorls, in having a different protoconch morphology (Figs 27 *vs* 30) and in having more numerous secondary spiral cords.

The variable spacing between penultimate and last (apertural) varix is an unusual feature observed in *F. roseotincta*. Such unusual cases of a distinct larger gap between these two varices are seen in two other muricopsine species: *Favartia rosamiae* (Fig. 14) and *F. varimutabilis* Houart, 1991 from the Lesser Antilles and southeastern Brazil.

Etymology. *roseotincta* (L): Named for its color which is reminiscent of a beautiful pink and white rose.



Figures 23-32

23-25. *Favartia (Favartia) marjoriae* (Melvill & Standen, 1903)
23. Persian Gulf, Sheikh Shuaib Island, 15 fms (27 m), syntype BMNH 1903.11.5.18.19, 27.5 mm.; **24-25.** Persian Gulf, IRSNB IG 10591, 29 mm.
26. *Favartia maculata* (Reeve, 1845), Thailand, Phuket Island, RH, 18.7 mm.

27-32. Protoconchs (scale bars 0.5 mm)
27. *Favartia (Favartia) colombi* n.sp (RH); **28.** *Favartia (Pygmaepterys) paulboschi* (RH); **29.** *Favartia (P.) yemenensis* (SG); **30.** *Favartia (F.) roseotincta* n. sp. (SG); **31.** *Favartia (F.) flexirostris* (RH); **32.** *Favartia (F.) rosamiae* (RH).

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Redescription and range extension of *Antillophos bahamasensis* Petuch, 2002 (Gastropoda: Buccinidae)

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KEYWORDS. Caribbean Sea, Buccinidae, *Antillophos*

ABSTRACT. *Antillophos bahamasensis* Petuch, 2002, previously known only from the type locality, is recorded from Guadeloupe. The species is redescribed based on this additional material.

Watters (2009) reviewed the western Atlantic Ocean species of *Antillophos*. At the time the species *Antillophos bahamasensis* Petuch, 2002, was known only from the faded holotype and a single paratype collected off Victory Cay, Bimini Chain, Bahamas, apparently from 35 m (Figures 1, 2). Because of the lack of material a description of the variability of the species was not possible. It was suggested that the species might even prove to be synonymous with the widespread *Antillophos chazaliei* (Dautzenberg, 1900).

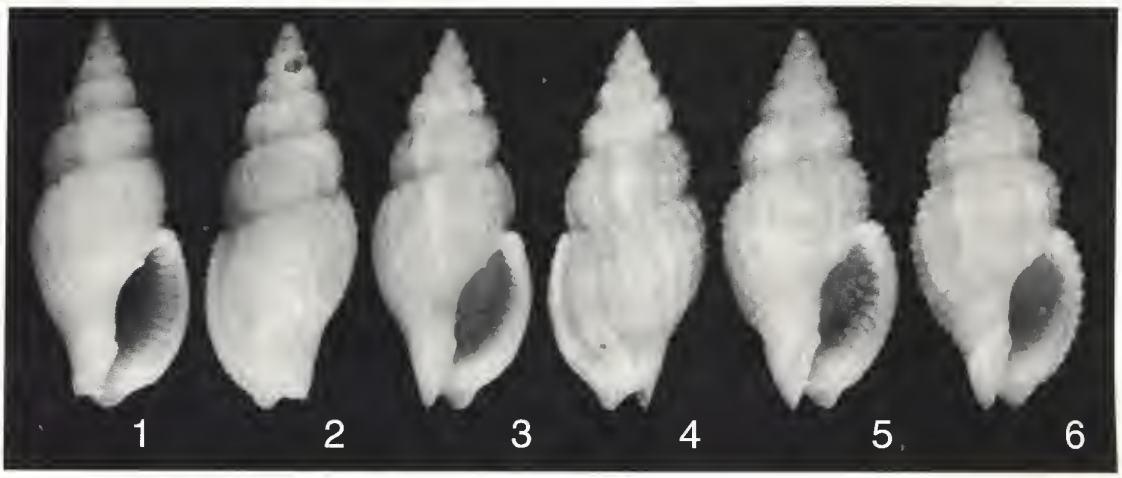
After publication of the review I was fortunate to receive numerous lots of *Antillophos* from Guadeloupe sent by Mr. Dominique Lamy. Five species were represented, some in abundance: *A. chazaliei* (Dautzenberg, 1900), *A. candeanus* (d'Orbigny, 1842), *A. smithi* (Watson, 1885), *A. beauii* (Fischer and Bernardi, 1857), and surprisingly, *A. bahamasensis*. Specimens of *A. bahamasensis* were recorded from Saint-Françoise, Grande-Terre (250 m) (Figure 3, 4), Basse-Terre (350 m) (Figure 5), and Port-Louis, Grande-Terre (150 m). At least one specimen was live-taken and the species was found either alone or in association with *A. smithi* and *A. beauii*. *Antillophos bahamasensis* appears to live in deeper water than most western Atlantic *Antillophos* and is obviously very rare in collections. These are also the first published records of *A. candeanus* and *A. chazaliei* from Guadeloupe, although well within the overall range of both species.

These new specimens not only increase the range of the species significantly, but indicate that the species is distinct from *A. chazaliei*, as well as allowing a more comprehensive description of the species beyond the type lot. Although quite similar, *A. bahamasensis* differs from *A. chazaliei* (Figure 6) in having more numerous axial ribs on the penultimate whorl (11 – 17 in *A. bahamasensis*, 8 – 12 in *A. chazaliei*), in having less pronounced sculpture, and in having the lirae in the outer lip broken into pustules (entire in *A. chazaliei*). The description given by Watters (2009) is herein modified and additional specimens are figured.

Description. Shell 12.8 – 18.0 mm in length. Fusiform; spire 50% – 60% of total length. Protoconch conical, of 2.25 – 2.5 smooth whorls with sharp keel at periphery near suture. Teleoconch of 6.5 whorls. Teleoconch whorls sculptured with narrow, widely spaced, flat, spiral cords separated by wide intervals, 14 – 17 on last whorl. Some interspaces with a single, fine, 2° spiral thread. Axial sculpture of widely-spaced, low, rounded ribs, 11 – 19 on last whorl (excluding varices) and 11 – 17 on penultimate whorl (excluding varices). Varices well-developed, about one varix every 1/3 – 1/4 turn including final last whorl (not apparent on holotype); occasionally varices may be adjacent to each other. Terminal varix low, wide, crossed by numerous axial ribs. Intersections of axial and spiral sculpture form pustulose, rachet-like sculpture. Aperture elongate-oval, with one plication anteriorly; anal canal set off by one or two denticles. Outer lip with 12 – 17 lirae deep within mouth, with occasional intercalated 2° ones; the primary lirae are broken up into peculiar linear pustules. Columella continuous; parietal lip adherent to previous whorl. Siphonal canal short, open. "Stromboid notch" shallow to of medium depth. Base color grayish-white, most specimens have some evidence of three brown spiral bands at suture, periphery, and siphonal canal; terminal varix always white without spots. Aperture white. Operculum leaf-shaped, tan, with anterior terminal nucleus. Radula and anatomy unknown.

ACKNOWLEDGEMENTS

I thank Mr. Dominique Lamy for the opportunity to study these important specimens.



Figures 1-6

1-5. *Antillophos bahamasensis* Petuch, 2002.
1-2. Holotype UF 277198, off Victory Cay, Bimini Chain, Bahamas, 18.0 mm length; **3-4.** Watters coll. 14435a, 250 m, Saint-Françoise, Grande-Terre, 17.3 mm length; **5.** BMSM 42999, 350 m, Basse-Terre, 12.9 mm length.
6. *Antillophos chazaliei* (Dautzenberg, 1900). Watters coll. 13749d, 150 m, Guadeloupe, 15.7 mm length.

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A new species of *Clelandella* (Gastropoda: Trochoidea: Trochidae: Cantharidinae) from Western Sahara

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KEYWORDS. Gastropoda, Trochoidea, Trochidae, Cantharidinae, Western Sahara, *Clelandella*, new species.

ABSTRACT. *Clelandella artilesi* n. sp., a new species from Western Sahara is described and compared with similar species from the north-eastern Atlantic, especially off West Africa.

RESUME. Une nouvelle espèce de *Clelandella* provenant du Sahara Occidental, *Clelandella artilesi* n. sp., est décrite et comparée avec d'autres espèces similaires de l'Atlantique Nord-est, plus particulièrement au large de l'Afrique Occidentale.

INTRODUCTION

Until the next last years, there was only a few literature about the malacofauna from off former French West Africa and the species from this area were still rather poorly known (see Vilvens & Swinnen, 2007 for an abbreviated historical account of the main expeditions in this area). By now, some valuable works have highlighted the malacofauna not only from West Africa but also from adjacent Atlantic islands such as Canary Is., Madeira Is. and Cape Verde Is. (e.g. Curini-Galletti, 1985; Segers, 2002; Ardovini & Cossignani, 2004; Gofas, 2005; Rolan, 2005; Rolan & Swinnen, 2009; Segers, Swinnen & De Prins, 2009).

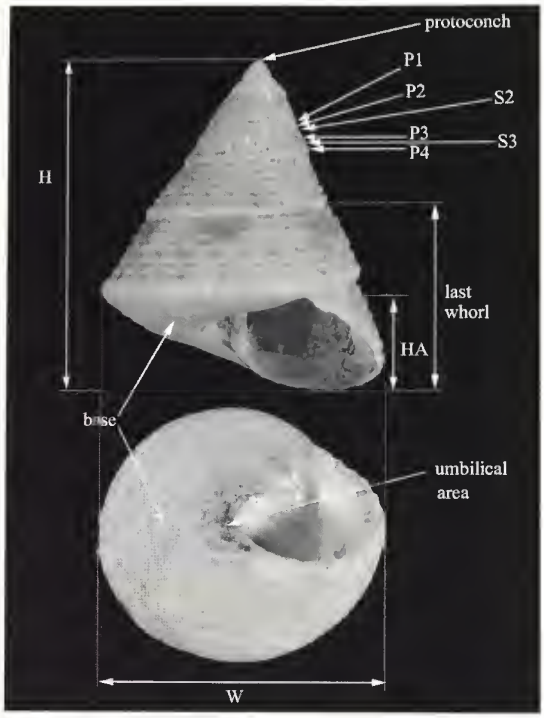
Among the species reported or newly described in all these papers and books, the Cantharidinae (accepted subfamily of the Trochidae family) species are rather numerous. This paper describes a new species that belongs to this subfamily.

Material and methods

The material studied was found by some dredging performed by dragging boats working in the Canary-Saharan fishing bank. All the shells where collected between 1993 and 2001, in an area off Western Sahara that goes from Cap Boujdour (Cabo Bojador: 22°18'N, 16°40'W) to Cap Barbas (Cabo Barbas: 26°07N, 14°29'W), at between 50-70 m deep on sandy bottoms (see text figure 2 below).

Regarding the description methodology, the main conchological features used are (see text figure 1 below) :

- general shape of the shell;
- shape of the whorls;
- spiral cords and axial threads of the whorls;
- spiral cords on the base;
- shape of the aperture, the outer and the inner lip;
- colour pattern.



Text figure 1 : Features of Cantharidinae shells; H : height; W : width; HA : height of the aperture; P1, P2, P3, ... : primary cords; S1, S2, S3, ... : secondary cords (shell : *Clelandella miliaris* (Brocchi, 1814), Brittany, Roscoff, 9.4 x 8.0 mm).

Statistical calculations have been performed with Microsoft Excel 2003 and Tanagra 1.4, a free statistical software from Lyon II University.

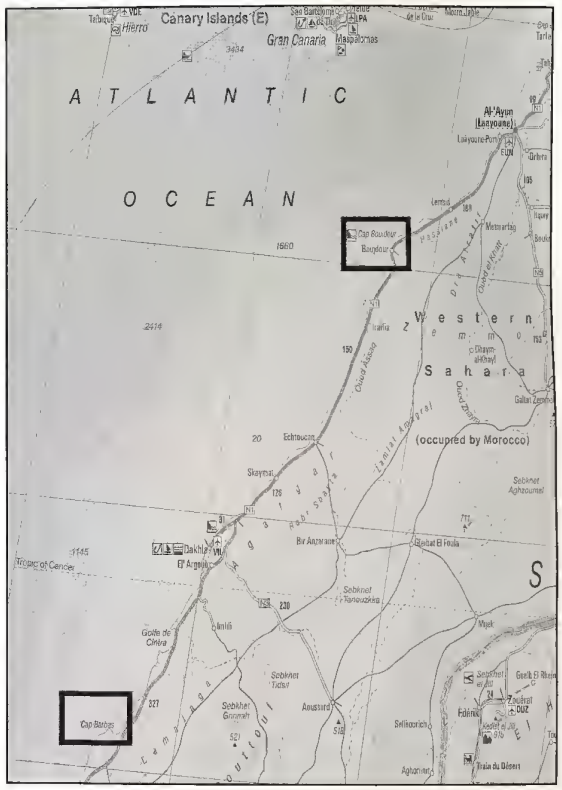
Abbreviations

Repository
IRSNB : Institut royal des Sciences naturelles de Belgique, Brussels, Belgium.
MNHN : Muséum national d'Histoire naturelle, Paris, France.

Other abbreviations
H : height
W : width
TW : number of teleoconch whorls
P1, P2, P3, ...: primary cords (P1 is the most adapical)
S1, S2, S3, ...: secondary cords (S1 is the most adapical)
lv : live-taken specimen(s) present in sample
dd : only dead specimen(s) present in sample
sub : subadult specimen(s)
juv : juvenile specimen(s)

SYSTEMATICS

We follow here the new classification of Williams et al. (2010) who has elevated the Cantharidini tribe (as it was considered by Hickman & McLean, 1990 and still by Bouchet & Rocroi (2005)) at a subfamily level of the Trochidae.



Text figure 2 : Prospecting area in this paper

Superfamily : **TROCHOIDEA** Rafinesque, 1815
Family : **TROCHIDAE** Rafinesque, 1815
Subfamily : **CANTHARIDINAE** Gray, 1857
Genus : ***Clelandella*** Winckworth, 1932
Type species : *Trochus clelandi* W.Wood, 1828 (=*Trochus miliaris* Brocchi, 1814) (by o.d.) – Pliocene, northern Italy.

Distinctive features. Shell rather small (height up to 14 mm for the known species), elevated spire almost as high as wide, conical shape with flat whorls. Smooth protoconch with a thin terminal varix. Rather strong spiral sculpture of beaded spiral cords. Angular to subangular periphery. Interrupted peristome, aperture prosocline, rhomboidal. Base from almost flat to moderately convex. No umbilicus or umbilicus very narrow. Variable colour, with various patterns.

Remarks. Gofas (2005) described recently 4 new species from north-western Atlantic and 1 new species from eastern Mediterranean.

Clelandella miliaris (Brocchi, 1814)
Figs 7-14, Text Figs 1, 3

Trochus miliaris Brocchi, 1814: 353, pl. 6, fig. 1. Type locality: northern Italy, no specified locality; lectotype from qualification as holotype.
Trochus clelandi – W. Wood, 1828: 16, pl. 5, fig. 15.
Trochus millegranus – Philippi, 1836: 183, pl. 10, fig. 25.
Calliostoma clelandi – Kaicher, 1979: card#2094.
Calliostoma miliaris – Poppe & Goto. 1991: 74, pl.6, fig. 9.
Clelandella miliaris – Giannuzzi-Savelli et al., 1994: 88, figs.279-281.
Clelandella miliaris – Cretella et al.,1999 : 72-74, figs. 13-15, 17-18, 25, 28, 33-34.
Calliostoma miliaris – Ardovini & Cossignani, 2004: 71.
Clelandella miliaris – Gofas, 2005: 134-136, figs. 1–3, 12A-B, 13A-B.
Clelandella miliaris – WoRMS, 2011: p=taxdetails&id=141774.

Material examined. France. Britanny, Finistère, near Ouessant, +/- 100 m, 40 dd. – Roscoff, +/- 3 m, 25 lv. **Italy.** Tuscany Archipelago, 2 lv. **Spain.** Off Malaga, 2 lv. **West Africa.** Off Mauritania, 17°45'N, 16°25'W, 3 lv, 1 juv lv.

Distribution. North-eastern Atlantic, from Norway to West Africa and Mediterranean Sea, 35-800 m.

Remarks. The main characteristics of this species are :
– height up to 14 mm, width up to 13.8 mm;
– a high spire, a conical shape, with up to 7 flat whorls;
– strongly prosocline axial threads and up to 8 spiral cords, granular by intersection with axial threads; on first whorl, 4 cords P1, P2, P3 and P4 appearing immediately, smooth; P1 slightly weaker than other cords; cords granular by intersection with axial threads as soon as second whorl; secondary cords S2 and S3 appearing by intercalation; P4 thicker on third whorl, dividing into 2 cords on fourth whorl, up to 10 cords on last whorl of big specimens, producing a thick rim making carina;
– columella nearly straight, oblique, with a weak median swelling;
- base almost flat, with 8 to 13 granular spiral cords;
- no umbilicus or very narrow umbilicus reduced to a small slit.

Nicklès (1950) reviewed the known marine species of Western and Equatorial Africa but curiously didn't mention this species. Kaicher (1979) still used the synonym name. At last, Cretella et al. (1999) produced an accurate study of this species.
This is a variable species (Gofas, 2005) regarding size and colour, also sometimes with a slightly cyrtoconoidal shape instead of a conical one and a subangular instead of angular periphery (some specimens from western Africa). Gofas mention even (without illustrations) some specimens from Ivory Coast with a narrow umbilicus.

Clelandella artilesi n. sp.
Figs 1-4, Table 1, Text Fig. 2, 3

Type material. Holotype (6.9 x 7.2 mm) IRSNB IG.31784/MT2330 for database DaRWIN. Paratypes: 1 MNHN 23351, 2 coll. F. Deniz Guerra, 2 coll. F.Swinnen, 1 coll. C.Vilvens.

Type locality. West Africa. Off Western Sahara, 50-60 m.

Material examined. West Africa. Off Western Sahara, 12/1999, 50-60 m, 2 dd sub, 3 dd juv. - Off Western Sahara, 7/2001, 50-60 m, 3 dd (with holotype and 2 paratypes). - Off Western Sahara, 1993-1999, 50-70 m, 15 dd, 7 dd sub, 2 dd juv (with 4 paratypes).

Distribution. West Africa, off Western Sahara, 50-60 m.

Diagnosis. A typical cantharid species with an elevated, conical spire, up to 6 even granular spiral cords on the whorls, an angular periphery, up to 6 or 7 smooth spiral cords on the base and a very narrow or closed umbilicus.

Description. *Shell* of moderate size for the genus (height up to 7.2 mm, width up to 5.1 mm), higher than wide, conical; spire elevated, height 1.2x to 1.4x width; angulate periphery; umbilicus closed or very narrow.
Protoconch about 180 µm wide, of 1 to 1.25 whorls, rounded, smooth with a thin, straight terminal lip.
Teleoconch of up to 6.9 whorls; two first whorls convex, other whorls almost straight, with spiral cords first smooth, granular later and axial threads much more stronger on abapical whorls than on adapical whorls. Suture visible, not canaliculated. First whorl convex, without axial sculpture and 4 smooth cords Pi (i=1,2,3,4) appearing almost immediately, P1 slightly later and weaker; interspace between cords about 1.5 larger than cords; all cord brown except P1 lighter; axial threads very weak, hard to detect; suture impressed, not canaliculated. On second whorl, S2 appearing at first midwhorl, S3 at second midwhorl, both quickly similar to Pi; all cords still smooth. On third whorl, all cords more or less similar in size, except P4 slightly stronger; distance between cords similar to cords; S4 may appear, partly covered by next whorl; weakly prosocline axial threads clearly visible on abapical part, especially between S3, P4 and S4. Shape of whorl weakly convex, almost straight near end. On fourth whorl, axial thread stronger between spiral cords; threads still weakly prosocline;

cords subgranular. On next whorls, spiral cords granular; interspaces almost as wide as cords, except interspace between S3 and P4 slightly greater. On last whorl, beads of P4 (sometimes also of S3) sharp; S4 appearing, thin, almost smooth to weakly subgranular, close to P4.

Aperture roundly rhomboidal; outer lip thin; inside nacreous.

Columella nearly straight, only slightly oblique, with a weak basal swelling forming a kind of blunt tooth.

Base weakly convex, with thin axial threads on whole surface and with 6 or 7 rather low, spiral cords; cords similar in size to the cords on whorls, weakly subgranular by intersection with axial threads; interspaces between cords grater than or equal to cords; axial threads much thinner and more crowded than axial threads on whorls.

No umbilicus or very narrow umbilicus reduced to a small slit.

Colour of teleoconch pinkish white, sometimes with brownish flames on first whorls only and with brownish dashes on peripheral cords, or sometimes with brownish flames on the whole whorls; protoconch off-white.

	TW	H	W	H/W	TW/H
holotype IRSNB	6.9	7.2	5.1	1.41	0.96
paratype MNHN	6.7	5.9	4.9	1.20	1.14
paratype FDG-1	6.5	5.8	4.6	1.26	1.12
paratype FDG-2	6.4	6.8	5	1.36	0.94
paratype FS-1	6.6	6.4	5	1.28	1.03
paratype FS-2	6.5	6.2	4.9	1.27	1.05
paratype CV	6.5	6.2	4.7	1.32	1.05
means	6.59	6.36	4.89	1.30	1.04
minima	6.40	5.80	4.60	1.20	0.94
maxima	6.90	7.20	5.10	1.41	1.14
standard deviation	0.17	0.50	0.18	0.07	0.07

Table 1. – *Clelandella artilesi* n. sp.: Shells measurements in mm for types (FDG : F. Deniz Guerra coll.; FS : F. Swinnen coll.; CV : C. Vilvens coll.).

Discussion. The new species is close to *Clelandella miliaris* (Brocchi, 1814) (Figs 7–14) but differs from it mainly by a greater height/width ratio (about 1.30 instead of about 1.15 for *C. miliaris* – see scatter plot there under showing the different slope for the regression lines), a spiral cord P4 similar in size to the other cords (instead of being much stronger, producing usually a prominent peripheral rim) never divided in or covered by thinner spiral cords (3-10 such cords are present on *C. miliaris*), axial threads weakly prosocline with an angle of about 30° with vertical (instead of 45°).

Plate 1. Figures 1-12. Scale bar: 1 mm.

1-4. *Clelandella artilesi* n. sp., West Africa. Off Western Sahara, 50-60 m. **1-2.** Holotype IRSNB (IG.31784), 7.2 x 5.1 mm. **3-4.** Paratype MNHN (23351), 5.9 x 4.9 mm.
5-6. *C. madeirensis* Gofas, 2005, holotype MNHN, Madeira archipelago, off Porto Santo, 430 m, 8.3 x 7.0 mm
7-14. *C. miliaris* (Brocchi, 1814). **7-8.** Off Mauritania, 6.2 x 5.7 mm. **9-10.** France, Britanny, Finistère, near Ouessant, 8.7 x 7.7 mm. **11-12.** Italy, Tuscany Archipelago, 9.1 x 7.1 mm. **13-14.** Spain, off Malaga, 15.2 x 12.8 mm.

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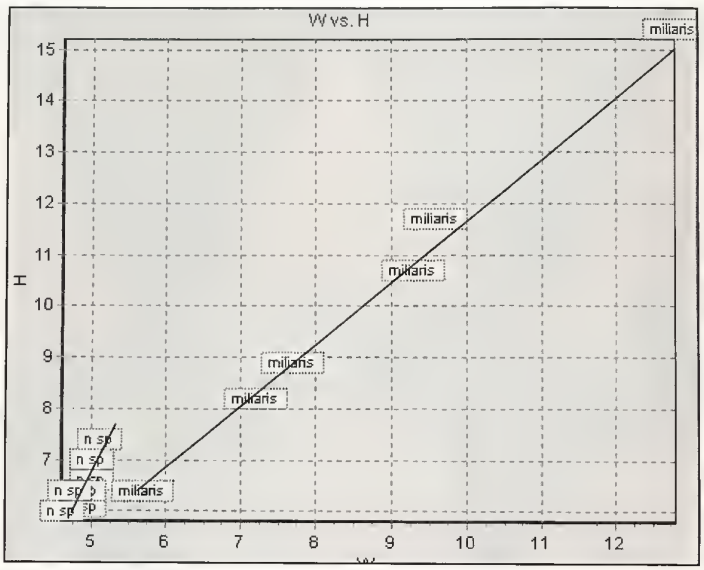

Text Figure 3 : Scatter plot for height (H) and width (W) of types *Clelandella artilesi* n. sp. of and some examined specimens of *C. miliaris*.

Clelandella artilesi n. sp. is also rather close to *Jujubinus catenatus* Ardovini, 2006 from Sicily, but this similar in size species has a more elevated spire (with a greater H/W ratio of about 1.50), a slightly cyrtoconoidal shape, a transversely elongated flared aperture, thinner spiral cords on the base and a different coloration with reddish brown cords on a light green background.

The new species may also be compared to *Clelandella madeirensis* Gofas, 2005 (Figs 5–6) from Madeira, but this species is slightly greater (height up to 8.3 mm for a similar number of whorls), has a different ontogeny of the cords (S3 appearing first, S2 later and 2 tertiary cords appearing and growing to reach the same size as the other cords, giving 9 spiral cords on the last whorl of the holotype), lacks the axial threads between the spiral cords and has more numerous (up to 12 or 13), uneven and thinner spiral cords on the base.

Etymology. After Miguel Artiles, collector from Arinaga, South East of the Island of Gran Canaria, interested in the marine malacofauna of the entire world and occasional collaborator of the third author for the study of land shells from Canarias.

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La liste des références, en ordre alphabétique, respectera la forme suivante (les titres des publications ne devraient pas être abrégés):

Keen, A.M. & Campbell, G.B. 1964. Ten new species of Typhinae (Gastropoda : Muricidae). *TheVeliger* 7(I): 46-57.
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Mayr, E. 1989. Attaching names to objects. In: *What the philosophy of biology is : essays for David Hull* (M. Ruse, ed.), Klumer Academic, Dordrecht: 235-243.
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A new species of *Mitra* (*Fusimitra*) (Gastropoda: Mitridae) from the northwestern Gulf of Mexico

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KEYWORDS. Mitridae, *Mitra* s.s., new species, Gulf of Mexico

ABSTRACT. A new species of *Mitra* (*Fusimitra*) inhabiting the pinnacles off the Louisiana coast is described and compared with *Mitra (F.) antillensis* Dall, 1889, its most similar congener.

INTRODUCTION

On the continental shelf off the Louisiana and Texas coasts there is a series of banks or "pinnacles" peculiar to the northwestern Gulf of Mexico. Their geological history indicates that at one time, when the sea- level was much lower, these were shallow intertidal areas where coral grew. Nowadays these banks, which arise abruptly from a soft, muddy bottom to 20 to 90 m from the surface, have a summit composed of calcareous rubble, a product of their former coral fauna. These formations have been discussed by Williams (1951), Stetson (1951), Goedicke (1955) and others; however, their molluscan fauna was not seriously addressed until Parker & Curray (1956), who listed a large number of species and noted their similarity to the shallow-water Caribbean fauna (*Idem*: 2428). The list of the rich molluscan fauna of the pinnacles was later expanded by a number of expeditions supported by grants, mostly from the National Science Foundation, to the Biology Department at the University of Louisiana at Lafayette. They have been reported elsewhere (García, 2000, 2002, 2007, 2008, 2010; García & Lee, 2002, 2003, 2004).

The new species of *Mitra* (*Fusimitra*) described herein seems to be confined to the top of the offshore pinnacles discussed above. Although there have been dredging cruises in the northeastern quadrant of the Gulf of Mexico south to Dry Tortugas, and in the southeastern quadrant at Bahía de Campeche, Mexico, no specimens of the new species have been collected in those areas. The 10 specimens that comprise the type material were collected during seven expeditions expanding a period of 11 years, from 2000 to 2010. Only two specimens have been collected alive.

All cruises were done on the R/V *Pelican*, a research vessel administered by the Louisiana Universities Marine Consortium (LUMCON) using a box dredge roughly 3 ft. by 3 ft. by 1 ft.

Abbreviations

BMSM: Bailey- Matthews Shell Museum, Sanibel, Florida, USA.
CMT: Charlotte M. Thorpe collection, Jacksonville Beach, Florida, USA.
EFG: author's collection
FF: Frank Frumar collection, Kirkwood, Missouri, USA.
SBMNH: Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
TCWC: The Texas Cooperative Wildlife Collection, Texas A & M University, College Station, Texas, USA.
USNM: United States National Museum, Washington, D.C., USA

SYSTEMATICS

Family **MITRIDAE** Swainson, 1829
Genus ***Mitra*** Lamarck, 1798
Type species: *Voluta episcopalis* Linnaeus, 1758 (= *V. mitra* Linnaeus, 1758 [ICZN, 1969]) by subsequent designation of Montfort (1810: 543).

***Mitra ulala* n. sp.**
Figs. 1-15

Type material. Holotype (Figs. 1-3) USNM 1155049, 28°05.95'N, 91°01.34'W, 69-68 m, length 30.5mm. width 10.3 mm; paratype 1 (Fig. 4) USNM 1155050, 28°06.217N, 91°070'W, 75-65 m, length 21.9 mm, width, 8.75 mm; paratype 2 USNM 1155051, 28°06.71'N, 91°02.50'W, 57-71 m, length, 22.o mm, width 8.7 mm; paratype 3. TCWC 4-5247, 28°05.76'N, 91°01.15'W -, 64.7-62.1 m, length 25.6 mm, width 9.2 mm; paratype 4 (Fig. 7) USNM 1155052, 27°58.01'N 92° 35.67'W, 75-85 m, length 27.1 mm, width 8.4 mm; paratype 5 (Fig. 8) BMSM 17952, 28° 6.21'N, 91° 2.23'W, 99.3 m, length 21.9 mm, width 8.0 mm; paratype 6 (Figs. 5-6) SBMNH 149759. 28°38.16'N, 89°33.19'W, 60-70 m, length 18.8 mm, width 7.6 mm; paratype 7 (Fig. 9) EFG 24308, 28°5.85'N, 91°1.28'W, 68.3 m, length 32.2 mm, width 10.8 mm; paratype 8 (Figs. 10-11) EFG 23177, 27° 59.141'N; 91° 38.832'W, 91-65 m, length 23.2 mm, width 7.8 mm; paratype 9 (Figs. 12-15) CMT, 28°05.552'N, 91°00.82'W, 63-64 m, length 23.7 mm, width 8.7 mm.

Type locality. Louisiana, off Isles Dernieres, 28°05.95'N, 91°01.34'W, 69-68 m

Distribution. Offshore Louisiana pinnacles, 57- 99 m.

Description. Shell up to 32.2 mm in length, elongate-ovate, average with/ length ratio 0.37. Protoconch damaged, slightly tilted from axis (Fig. 14), of at least 3 smooth, conical, tan whorls. Teleoconch of 8 whorls; whorls very narrowly shouldered, straight-sided. Suture channeled. Axial sculpture of numerous narrow, strong cords on first 5 or 6 whorls; cords narrower than interspaces, diminishing in strength on later whorls, obsolete on last whorl. Spiral sculpture of 4 strong, wide cords on early whorls, 5 on later whorls; interspaces pitted; cords becoming strongly nodulous as they cross over axial elements, creating a strong clathrate pattern of nodes and pits on first 5 whorls (Figs. 3, 6, 11), diminishing in strength on later whorls, obsolete on last whorl of mature specimens except for two cords next to suture and at base of whorl, where numerous weak, slightly nodulous spiral cords still show. Aperture approximately half the length of shell, narrowly pointed posteriorly, with relatively wide siphonal canal anteriorly; outer lip simple, only slightly thickened; parietal wall of adult specimens with well-delineated, thin callus posteriorly, thickened and slightly raised anteriorly, producing 4 columellar folds; posterior fold largest, prominent; next two folds proportionately smaller; last fold almost obsolete. Shell rusty-brown in fresh specimens, with white amorphous white blotches at suture; blotches tending to form small to large axial flammules that may cross entire whorl; a well-delineated to nebulous white band appearing at mid-section of last whorl; aperture in fresh specimens mauve. Animal translucent-white, with opaque, white to pale- yellow blotches; foot and siphon pale yellowish-cream (Fig. 15).

Remarks. Cernohorsky (1976: 383) differentiates *Fusimitra* Conrad, 1855 from other subgenera in Mitridae by its early whorls showing a clathrate sculpture similar to *Cancilla* but adult whorls becoming smoother, not unlike those of *Mitra* s.s. As these characters apply to *Mitra ulala*, I have placed this new species in *Fusimitra*.

The type series of *Mitra (Fusimitra) ulala* is consistent in most characters. The two variables are the basic color, which ranges from rusty-brown in live collected specimens to orange and yellow in older specimens, and the quantity and shape of the white blotching. Only one, a live-collected specimen, had an almost intact protoconch, which is tilted (Fig. 14); the second live-collected specimen has a partial protoconch that also seems to be tilted. However, at this point one cannot be sure if this is a true character of the species.

Mitra (Fusimitra) ulala n. sp. is very different from most other western Atlantic *Mitra* s.s. such as *Mitra barbadensis* (Gmelin, 1791), *Mitra damasomonteiroi* Cossignani & Cossignani, 2007, *Mitra espinosai* Sarasúa, 1978, *Mitra lenhilli* Petuch, 1988, *Mitra leonardi* Petuch, 1990, *Mitra nodulosa* (Gmelin, 1791), *Mitra pallida* Usticke, 1959, and *Mitra semiferruginea* Reeve, 1845. It can only be confused with its congener, *Mitra (F.) antillensis* Dall, 1889.

Mitra antillensis (Figs. 16-20) is a widespread species, ranging from North Carolina to Brazil. It is very rare in the Gulf of Mexico, most of the specimens having been found in the southeastern quadrant of the Gulf. To the author's knowledge, only three specimens have been collected in the northwestern Gulf of Mexico, one off Texas, at Alaminos Station 72-A4 (Fig. 19) and two off Louisiana: at Diaphus Bank, 28°5'N, 90°42'W, in 92 m (length 52.5 mm, width 15.6 mm); and at one of the pinnacles, 27° 49 N 92° 53.5 W, 75-85 m (Figs. 17-18). These three specimens are consistent with USNM 62103 (Fig. 16), the specimen designated by Cernohorsky (1976: 387- 388; pl. 326, fig. 4) as the "selected holotype" (lectotype) for this taxon and preclude the possibility that *Mitra ulala* is an ecomorph of *M. antillensis*. *Mitra antillensis* differs from the new species in the following characters:

1. It grows to a larger size. The lectotype has 8 teleoconch whorls and measures 81 mm. The holotype as well as paratypes 7 and 8 of *M. ulala* also have 8 teleoconch whorls and measure respectively 30.5mm, 32.2 mm and 23.2 mm; moreover, all other paratypes, which measure 18.8 mm to 27.1 mm, have at least 7 whorls.

Figures 1-11. *Mitra ulala* n. sp.

1-3. Holotype USNM 1155049, 28°05.95'N, 91°01.34'W, 69-68 m, length 30.5mm. width 10.3 mm. **4.** Paratype 1, USNM 1155050, 28°06.217N, 91°070'W, 75-65 m, length 21.9 mm, width, 8.75 mm. **5-6**. Paratype 6 SBMNH 149759, 28°38.16'N89°33.19'W, 60-70 m, length 18.8 mm, width 7.6 mm **7.** Paratype 4 USNM 1155052, 27°58.01'N 92° 35.67'W, 75-85 m, length 27.1 mm, width 8.4 mm. **8.** Paratype 5, BMSM 17952, 28° 6.21'N, 91° 2.23'W, 99.3 m, length 21.9 mm, width 8.0 mm. **9.** Paratype 7, EFG 24308, 28°5.85'N, 91°1.28'W, 68.3 m, length 32.2 mm, width 10.8 mm. **10-11**. Paratype 8, EFG 23177, 27° 59.141'N; 91° 38.832'W, 91-65 m, length 23.2 mm, width 7.8 mm.

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2. It is proportionately narrower than the new species. The lectotype, and four specimens from the Gulf of Mexico (1 from Dry Tortugas, 2 from Louisiana, and 1 from Texas) have respectively a width/length ratio (W/L) of 0.29, 0.30, 0.30 and 0.29. The type material of *M. ulala* ranges from 0.34 to 0.40, with an average of 0.37 W/L.

3. Its surface sculpture is different. *Mitra antillensis* has a sculpture dominated by spiral elements, which become unusually strong below the suture, 3 or 4 in earlier whorls, 6 or 7 on last whorl. In *M. ulala* the spiral sculpture near the shoulder is of equal strength on all teleoconch whorls, and only two cords show by the body whorl suture of two adult specimens. Moreover, the first 5 whorls of *M. ulala* have strongly developed axial and spiral elements (Figs. 3, 6, and 11). Although some specimens of *M. antillensis* from Barbados are more heavily sculptured on early whorls than those from more northern latitudes, they don't show the heavily clathrate pattern of the new species. Finally, the number of spiral cords on *Mitra antillensis* continue to increase with each whorl, the lectotype showing about 10 on the penultimate whorl. *Mitra ulala* has 4 on early whorls and no more than 5 on later whorls (Compare Figs. 3 and 18).

4. The coloration of *Mitra antillensis* is rather subdued, from grayish-white to tan, sometimes with a suffused white band by the suture; it also has an olivaceous periostracum. *Mitra ulala* has a thin, transparent periostracum and a pattern of coloration not found in *M. antillensis*.

Etymology. Named for the University of Louisiana at Lafayette, located in Acadia Parish, a French-speaking area of Louisiana. Although its official acronym is ULL, the jovial acronym "ULALA" has been used to refer to this institution.

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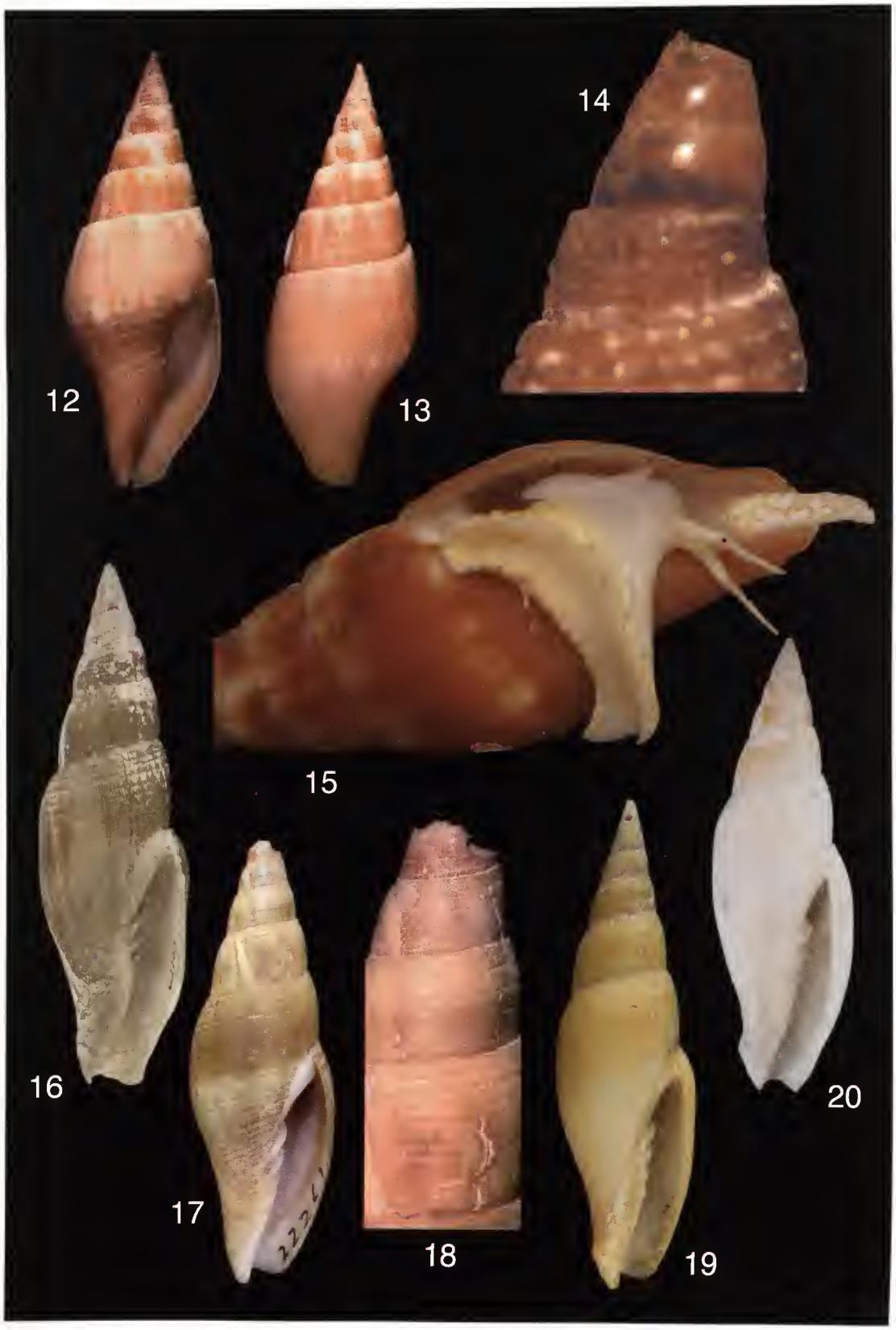
Figures 12-20

12-15. *Mitra ulala* n. sp. Paratype 9 CMT, 28°05.552'N, 91°00.82'W, i63-64 m, length 23.7 mm, width 8.7 mm. (Photograph of Fig. 15 by Charlotte Thorpe). **16- 20.** *Mitra antillensis* Dall, 1889. **16.** Lectotype, USNM 62103, 36 mi SE of Cape Lokout, North Carolina, 336 m, length 81.0 mm, width 40.0 mm (Photo credit: Mignonette Doley Johnson). **17-18**. EFG 22261, Louisiana, 27° 49 N 92° 53.5 W, 75-85 m, length (approx.) 48 mm, width 14.5 mm. **19**. TCWC 4- 2600, Texas, Alaminos Station 72-A4, 28°34.7'N, 92° 05.5'W,39 m, length 59.9 mm, width 17,1 mm. **20.** FF, 16 mi. SW of Key West, Florida, 167 m (Photo credit: Steve Kern).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A new species, a lost type and its forgotten name and more terebrid discoveries in the Caribbean (Gastropoda: Terebridae)

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KEY WORDS. Terebridae, Caribbean, Western Atlantic, Guadeloupe, *Terebra* (s. l.) *lamyi* sp. nov., *Terebra limatula*, shell morphology, biodiversity.

ABSTRACT. A small collection of terebrid specimens from Guadeloupe is discussed, with the description of a new species *Terebra* (s. l.) *lamyi* sp. nov. and the history of the taxon *Terebra limatula* Dall, 1889 is extensively researched.

INTRODUCTION

While examining specimens of the new species hereafter described, several terebrid experts were asked for an opinion as to their identity.

One responded that the typical reticulated/beaded sculpture is a feature typically seen in deeper water species from the Caribbean and adjacent areas. Although it bore almost no resemblance to any known species, he advised the author to study also the "forgotten species" *Terebra limatula* Dall, 1889a as the new shell could well match its very short description. As mentioned by Bratcher & Cernohorsky (1987), the type was thought to be lost and in fact the original description offers little discriminative help, so this investigative lead was easily rejected. It wasn't until a quick search in the online type database of the USNM was performed that specimens were found logged as *Terebra limatula.* This contradicted earlier report and prompted further investigation. Not only was there more than one syntype but the shells were actually present in the type collection and fitted the description and each were identical with one another. The present paper tries to clarify the situation, and its effects.

Material and methods

All specimens from Guadeloupe were collected by Mr Dominique Lamy and reside in his private collection unless otherwise mentioned. All pictures of these specimens were taken by the collector, with the exception of the new species *Terebra* (s. l.) *lamyi* sp. nov. which were taken by the author.
All pictures of type material held in the USNM were provided by Ellen Strong.
All pictures of type material held in the ANSP were provided by Paul Callomon.

Abbreviations

ANSP: Academy of Natural Sciences, Philadelphia, PA, USA
INV: Instituto de Investigaciones Marinas, Santa Maria, Colombia
MCZ: Museum of Comparative Zoology, Harvard, MA, USA
MNHN: Muséum national d'Histoire naturelle, Paris, France
MZUSP: Museu Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil
RBINS: Royal Belgian Institute of Natural Sciences, Brussels, Belgium
USNM: United States Nation Museum - The Smithsonian Institute, Washington, DC, USA
DL: Private collection Dominique Lamy, Guadeloupe
YT: Private collection of Yves Terryn, Belgium

Ancient history

W. H. Dall (1889a: 66) described the species *Terebra* (*Acus*) *limatula* in the reports of the *Albatross*-expedition to the Caribbean. The type locality was not actually given but he enumerated a list of localities as 'habitat': "*Barbados, 100 fms; Gulf of Mexico at Station 36, in 84 fms.; Bahamas, west of North Bemini* (sic!), *in 200 fms (Dr. Rush); US Fish Commission Station 2402, in the Gulf of Mexico, between the delta of the Mississippi and Cedar Keys, Fla., in 111 fms., mud; and Station 2610, 24 miles S. E. from Cape Lookout on the Carolina coast, in 22 fms., sand, bottom temperature 79°.0F.*"

Dall mentioned no total number of specimens he had before him and only lists the size of a specimen as being 18.0 mm long, 3.5 mm wide and with 14 whorls. The actual description of its discriminative features is a bit scattered throughout the manuscript: in a key and in the actual short description, and can be summarized as follows: Shell small, acute, elongate, columella not keeled, whorls flat. Strongly cancellate sculpture and nodulose at the interstices, about 18-20 costae on the body whorl. Subsutural band nodulose and 2-4 spiral rows of nodules on the remainder of the whorl. Color white to pale buff.

Dall furthermore mentioned the possible need to distinguish the specimens coming from 'more North'

i.e. South Carolina, USA as var. *acrior*, defined as having only 2-3 spiral rows that are not as strongly sculptured.

After its description the taxon was rarely used again, often in faunistic lists, only twice crudely figured e.g. Dall, 1889b: 94; Dall & Simpson, 1901: pl. 29, fig. N; de Jong & Kristensen, 1965: 47; Warmke & Abbott, 1962: 133 (as var. *acrior*); Abbott, 1968: 164 (as a subspecies of *Terebra protexta*); Kaicher, 1981: card 2710 ("holotype" of *Terebra acrior*); de Jong & Coomans, 1988: 104. In all these cases the identity of the taxon could not be well defined by description, drawing or picture.

Recent history

The name *Terebra limatula* was mentioned also in the Terebridae revision by Bratcher and Cernohorsky (1987: 30), who listed the species as dubious because the type material was thought to be lost and the description was considered too general to be of any help.

While the present author was revising all relevant taxa for a possible comparison with *Terebra* (s. l.) *lamyi* sp. nov., the name *Terebra limatula* remained enigmatic because of its description and 'lost types'. A quick search by Dr Ellen Strong (Curator of Mollusca, USNM, USA) revealed that possible 'types' are present at the USNM. Upon a more in-depth look through the type collection and records of the USNM, she was able to trace back four (+1 possible) records labeled as syntypes of *Terebra limatula* and var. *acrior*:

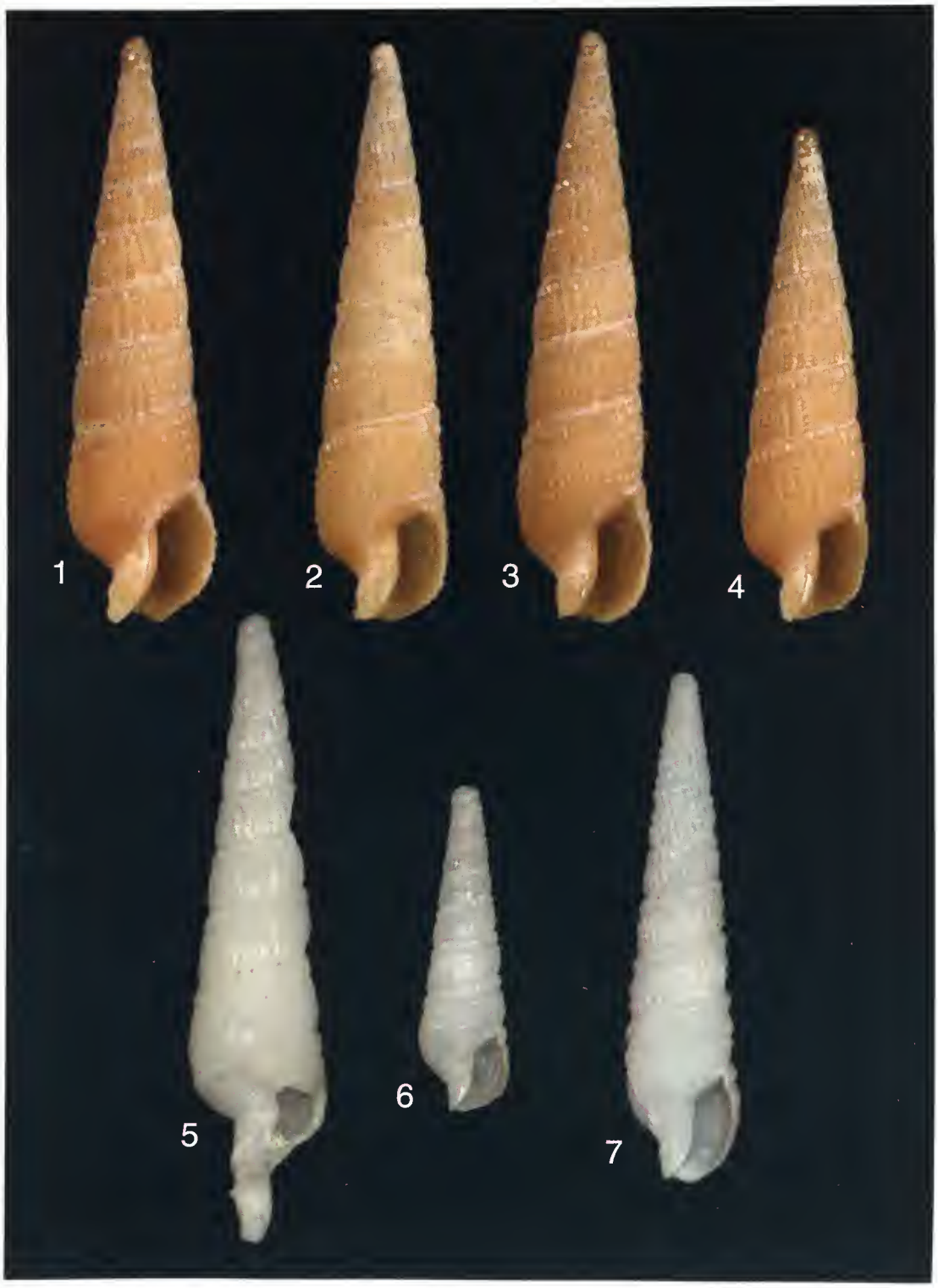
USNM 103436: Unconfirmed type, not listed in the online database because of its unconfirmed status. United States Fish Commission, Station 2120, at 134 m, Grenada.
The specimen was catalogued Jan. 31, 1890, simply as "*Terebra*", is conspecific with the hereafter-mentioned specimens but is clearly does not belong to the original type series as noted by Dall (see above).
USNM 92870: Catalogued February 13, 1888 with no identification. 1 specimen in dry condition. Collected 19 October 1885, RV *Albatross*, US Fish Commission Station 2610, North Carolina Cape Lookout at 40 m.
USNM 93971: Catalogued March 20, 1888 with no identification. 1 specimen in dry condition. Collected 14 March 1885, RV *Albatross*, US Fish Commission Station 2402 Florida, between Mississippi Delta and Cedar Keys at 203 m, 34.33N - 76.2W.
USNM 61229: 2 specimens in dry condition; collected by W. Rush, Bahamas, NW Bimini Island at 366 m. Additional notes accompanying this sample in the USNM mention: "see also USNM 92870, 93971; ANSP 33723 (syntypes)".
The specimen was catalogued Dec. 19, 1885, and labeled "*Terebra*". Specimens are currently out on loan.
USNM 87294: *Terebra* (*Acus*) *limatula* var. *acrior* Dall, 1889. 1 specimen in dry condition. RV *Blake*. US Coast Survey Station 100, Barbados, 13.167N - 59.533W at 183 m. Leg. A. Agassiz. The specimen was catalogued June 17, 1888 and labeled as "*Acus limatulus* Dall" Specimen is currently out on loan.

The database notes field in the type record USNM 61229 mentions additional specimens or types in the ANSP. An investigation by Paul Callomon (Curator of Mollusca, ANSP, USA) revealed the following:

ANSP 33723: 3 'syntypes' with the following information on the labels:
Original label: *L. protexta* Cow / Bemini, Bahamas [sic! = Bimini] / Dr. Wm. H. Rush!
Subsequent label 1: *Terebra limatula* form *acrior* Dall / det. T. Bratcher / 17 Oct 1981.
Subsequent label 2: Probable syntypes of *Terebra limatula* Dall, 1889 / A. R. Kabat, 17 Feb 1995.
One specimen (9.3 mm) seems conspecific with all the 'syntypes' of *Terebra limatula* in the USNM, but the other two (6.0 mm & 12.2 mm) clearly belong to a different species (and genus/group). Why these three were kept together as one species and regarded as such by Bratcher is a complete mystery as the difference is quite evident. A bit of research revealed that the two belong in fact to a probably undescribed species.
The total amount of 'syntypes' is thus actually six, five for *limatula* and one for *limatula* var. *acrior*. They are deposited in two museums: five (of which one is of *limatula* var. *acrior*) in USNM and one in ANSP.
As quoted above, the var. *acrior* is merely based upon small differences in the strength of sculpture and number of spiral rows of beads. As it concerns a smaller specimen than the specimens of the nominative type, we can conclude that this represents a mere juvenile of the latter. Thus *Terebra limatula* var. *acrior* is here interpreted as a junior synonym of *Terebra* (s. l.) *limatula*.

Figures 1-7

1-4. *Terebra lamyi* sp. nov. **1.** MNHN 23204, Holotype, 10.8 mm, Guadeloupe, off Saint François, 250 m; **2.** DL, Paratype, 1 10.6 mm, Guadeloupe, off Saint François, 250 m; **3.** YT, Paratype, 3 10.7 mm, Guadeloupe, off Saint François, 250 m; **4.** DL, Paratype, 2 9.1 mm, Guadeloupe, off Saint François, 250 m.
5-6. *Terebra* species 1. **5.** ANSP 425025, 12.2 mm, Bahamas, N Bimini Island, 366 m; **6.** ANSP 425025, 5.9 mm, Bahamas, N Bimini Island, 366 m.
7. *Terebra limatula* ANSP 33723, paralectotype, 9.3 mm, Bahamas, N Bimini Island, 366 m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As mentioned above, Bratcher & Cernohorsky (1987) considered the type of *Terebra limatula* and var. *acrior* to be lost. Subsequent researchers amateurs studying terebrids from the Caribbean and adjacent areas have often ignored the taxon.

Since then, however quite a number of West Atlantic/Caribbean 'cancellate' and/or 'beaded' terebrids have been described that resemble *Terebra limatula*:

Terebra (s. l.) *crassireticulata* Simone, 1999 = nom. nov. pro *Terebra reticulata* Simone & Verrisimo, 1995;
Terebra (s. l.) *colombiensis* Simone & Gracia, 2006;
Terebra (s. l.) *simonei* Lima, Tenorio & Barros, 2007;
And to a lesser extent, we can add the following to the list:
Terebra (s. l.) *leptapsis* Simone, 1999 = *Terebra doellojuradoi* Carcelles, 1953 *fide* Faber, 2007, synonymy agreed;
Terebra (s. l.) *intumescyra* Lima, Tenorio & Barros, 2007;
Terebra (s. l.) *alagoensis* Lima, Tenorio & Barros, 2007.
The discovery of the types of *Terebra* (s. l.) *limatula* might affect the validity of the species here mentioned, and this is discussed below.

Further discoveries

The fishing and collecting operations around the island of Guadeloupe by Mr Dominique Lamy have yielded over the last decades a large number of rare discoveries in malacology thanks to his personal investment of time and vigorous effort and because of his particular fishing methods (dredgings, baited bottle traps etc...). Besides the above-mentioned newly described species newly, a number of noteworthy species/specimens are here briefly commented on and figured. All the taxa will need further investigation to better understand the intraspecific variability of these hard to obtain deeper water species, but this must await the arrival of further specimens. The present enumeration serves merely as a photographic iconography to illustrate the difficulty of research, the huge variety and biodiversity in the Terebridae of the Caribbean, and our lack of knowledge of the fauna. No attempt has been made at this stage to assign taxa or even give detailed descriptions as they would be based on incomplete, dead collected or too few specimens.

SYSTEMATICS

Family TEREBRIDAE Mörch, 1852

All species here discussed and described will be placed in the informal grouping *Terebra* (s. l.) (thus *sensu* Bratcher & Cernohorsky, 1987) as opposed to *Terebra* s. s. (*sensu* Terryn, 2007), unless otherwise mentioned. The actual generic status of the species is the subject of continuous research and will be updated as information comes available.

Terebra lamyi sp. nov.
Figs 1-4

Type material. Holotype MNHN 23204, dredged off Saint François, Guadeloupe at 250 m, 10.8 mm.
Paratypes. All dredged off Saint François, Guadeloupe at 250 m - Paratype 1: DL, 10.6 mm; Paratype 2: DL, 9.1 mm; Paratype 3: YT, 10.7 mm.

Type Locality. Off Saint François, Guadeloupe. Dredged on muddy bottom at 250 m.

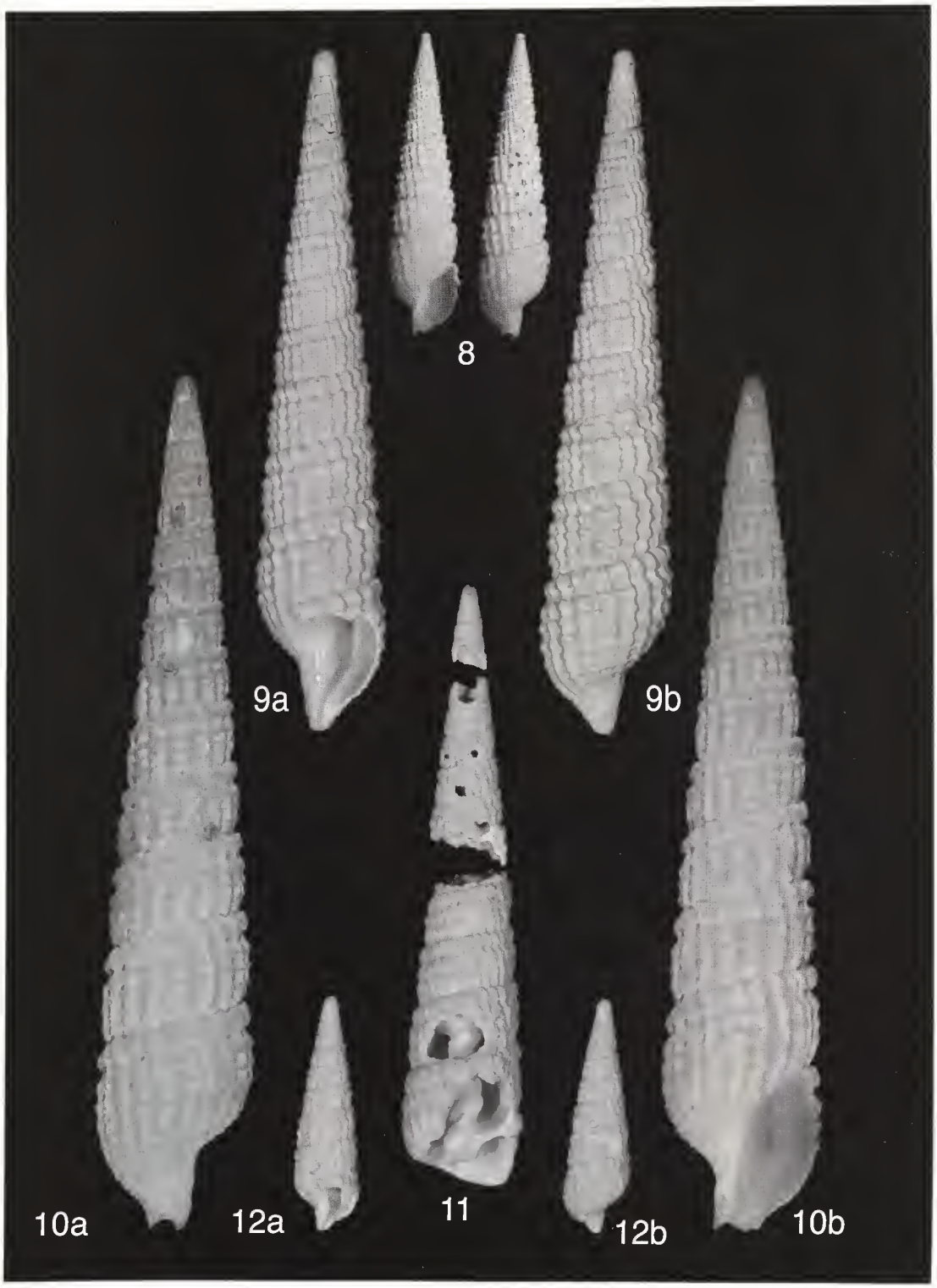
Additional material. DL, 1 specimen dredged at 150 m off Port Louis.

Distribution. Known only from the type locality and off Port Louis.

Habitat. All specimens were dredged on a muddy substrate. Presumed bathymetrical range for living specimens between 150 and 250 m.

Figures 8-12

8. *Terebra colombiensis* Simone & Gracia, 2006. INVMOL 1963, paratype, 15.5 mm, off Bocas de Ceniza, Colombia, 312-326 m. (Courtesy of Luiz Ricardo L. Simone, MZUSP) (x 0.5).
9. *Terebra limatula* Dall, 1889. USNM 93971, lectotype, 17.9 mm, USA, Florida, between Mississippi Delta and Cedar Keys, 203 m. (Courtesy of Ellen Strong, USNM).
10. *Terebra reticulata* Simone & Verissimo, 1995. MZUSP 27930, holotype, 22.2 mm, slope off Ubatuba, Sao Paulo, Brazil, 320 m. (Picture courtesy of Luiz Ricardo L. Simone, MZUSP).
11-12. *Terebra limatula* Dall, 1889. 11. USNM 92870, paralectotype, 14.7 mm (reconstructed estimate), USA, North Carolina, Cape Lookout, 40 m. (Photo courtesy of Ellen Strong, USNM). 12. USNM 103436, 5.9 mm, Grenada, 134 m. (Photo courtesy of Ellen Strong, USNM).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Description. Shell small to 11 mm. Shell color maroon to fawn; subsutural band often giving a somewhat lighter appearance. Outline of whorls slightly concave to almost straight. Protoconch of about 2.0 whorls; shiny brown. Subsutural band decorated with numerous axial ribs, as numerous as on the remainder of the whorl. Subsutural band delimited by a deeper groove compared to those on the remainder of the whorl. Axial sculpture of numerous slightly arcuate to mostly straight ribs, wider than the interspace. Spiral sculpture of 5-6 grooves, somewhat cutting the axial ribs; all giving the shell a somewhat elongate-beaded appearance. Columella curved with a shiny brown callous. Animal and operculum unknown.

Etymology. The species is named in honor of the Guadeloupe conchologist Mr Dominique Lamy in gratitude for providing the conchological community with molluscan material from Guadeloupe, including the here-described species.

Terebra species 1
Figs 5-6

Material: ANSP 425025, previously included in ANSP 33723, 2 sps.

Locality data: Bimini, Bahamas.

Commentary: Protoconch with about 2 whorls, mamillate. Subsutural band and remainder of whorl of identical sculpture consisting of numerous low axial ribs. Radial sculpture consisting of numerous shallow grooves. Subsutural marcation consisting of a shallow groove, yet deeper incised than the radial scupture: 1-2 radial grooves on the subsutural band there, about 5-6 on the remainder of the whorl (measured on the largest specimens penultimate whorl).

Discussion and comparison: Both specimens are small, heavily damaged and badly eroded, probably representing dead juveniles or subadult forms. Clear description of the features therefore is not possible. However it is very evident that these two specimens are not conspecific with the '*limatula*' contained in the original type lot ANSP33723. Both the difference in protoconch and sculpture is very evident. Hence the two specimens should be separated out of the type sample, leaving only 1 paralectotype of *Terebra* (s. l.) *limatula* in ANSP33723 (see further).

Terebra limatula Dall, 1889
Figs 7, 9-12

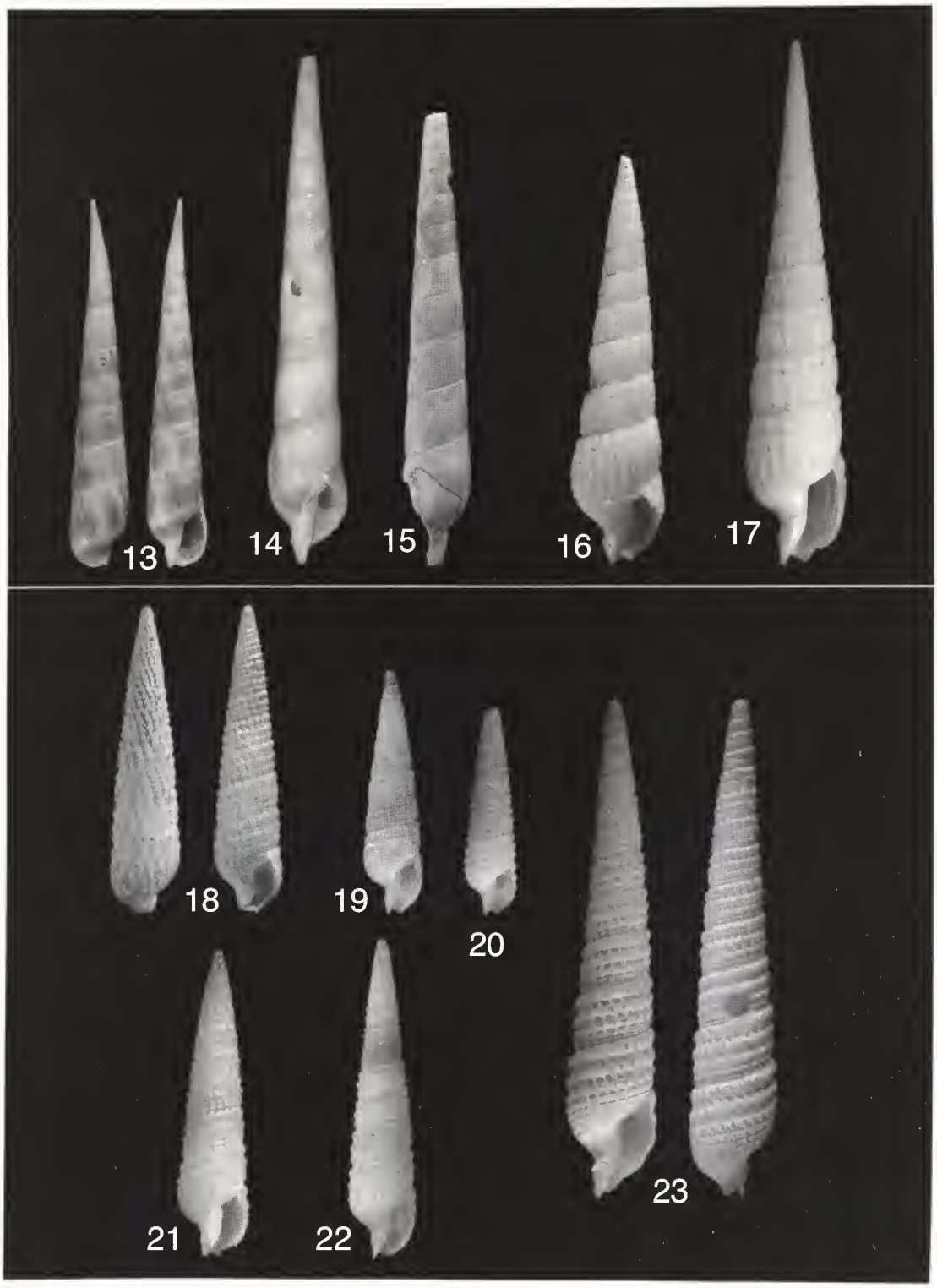
Terebra (*Acus*) *limatula* Dall, 1889a: 66.
Terebra (*Acus*) *limatula* var. *acrior* Dall, 1889a: 66.
Terebra crassireticulata Simone, 1999 (= nom. nov. pro *Terebra reticulata* Simone & Verissimo, 1995): 222.

Type material

Terebra limatula: USNM 92870: 1 specimen (dry). Collected 19 October 1885, RV *Albatross*, US Fish Commission Station 2610, North Carolina Cape Lookout at 40 m; USNM 93971: 1 specimen (dry). Collected 14 March 1885, RV *Albatross*, US Fish Commission Station 2402 Florida, between Mississippi Delta and Cedar Keys at 203 m, 34.33N - 76.2W; USNM 61229: 2 specimens (dry); collected by W. Rush, Bahamas, N Bimini Island at 366 m; ANSP 33723: 1 specimen (dry); collected by W. Rush, Bahamas, N Bimini Island at 366 m, 9.3 mm (see above).
The specimen registered as USNM 93971 (Fig. 9) is selected as the lectotype, in order to enhance the stability of the nomenclature in accordance with ICZN art. 74.7.3. All other type material specimens of *Terebra limatula* (USNM 92870, USNM 61229) and ANSP (33723) are paralectotypes.
Terebra limatula var. ***acrior***: USNM 87294: *Terebra* (*Acus*) *limatula* var. *acrior* Dall, 1889. 1 specimen in dry condition. RV *Blake*. US Coast Survey, Barbados, 13.167N - 59.533W at 183 m.
Terebra reticulata: MZUSP 27930: 1 specimen in dry condition. Station 5361, 24°42'0"S-44°30'5"W, slope off Ubatuba, Sao Paulo, Brazil, 320 m. Numerous paratypes at MZUSP.
Terebra crassireticulata: Although *Terebra crassireticulata* was a re-naming of *Terebra reticulata*, a heading was made in the manuscript entitled 'type material' which lists a large number of specimens from the MNHN but without formally designating types. Assumed is that this was a mere editorial lapsus.

Figures 13-23 (All from coll. Dominique Lamy and from Guadeloupe).

13-15. *Terebra evelynae* Clench & Aguayo, 1939. **13.** 51.1 mm, off Saint-François, 250 m. **14.** 69.7 mm, off Nord Grande-Terre, 300 m. **15.** 62.5 mm, off Nord Grande-terre, 300 m.
16. *Terebra glossema* Schwengel, 1940. 23.3 mm, off Port-Louis, 150 m.
17. *Terebra* species 2. 29.8 mm, off Port-Louis, 100 m.
18-19. *Terebra* species 3. 18. 9.2 mm, off Saint-François, 250 m. 19. 7.4 mm, off Anse La Gourde, 250 m.
20-22. *Terebra* species 4. 20. 6.2 mm, off Anse La Gourde, 250 m. 21. 9.1 mm, off Anse La Goude, 250 m. 22. 9.5 mm, off Vieux Habitants, 300 m.
23. *Terebra* species 5. 14.7 mm, off Saint-François, 250 m.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Additional material studied. USNM 103436 (see remarks above).

Type locality. Lectotype: US Fish Commission Station 2402, Florida, between Mississippi Delta and Cedar Keys at 203 m, 34.33N - 76.2W

Description. See Simone & Verissimo, 1995; Simone, 1999 for an extensive description of both the shell morphology and anatomy. The holotype of *Terebra crassireticulata* shows exactly the same protoconch and shell morphology as *Terebra limatula*. The specimens of *Terebra limatula* studied were all shells with damaged body whorl (columellar plicae visible), compared to the fully adult and complete holotype of *Terebra crassireticulata* with thickened columellar callus.

Habitat. Unknown.

Distribution. From North Carolina, Florida and the Bahamas (Dall, 1889a), probably South along the chain of islands bordering the Atlantic to Brazil, where it has been confirmed from Rio de Janeiro to Sao Paulo (Simone, 1999).

Terebra evelynae Clench & Aguayo, 1939
Figs 13-15

The species is easily identifiable among the West Atlantic and Caribbean terebrids but has been rarely recorded. Only a handful of dead collected specimens are known besides the live collected holotype (MCZ 135077: 118.3 mm). As far as the author could determine, the species had only been recorded from off Cuba (type locality: off N Santa Clara Province, 225 fms) till the present discovery of one live and several dead (crabbed) collected specimens off Guadeloupe.

Terebra glossema Schwengel, 1940
Fig. 16

The species is fairly identifiable amongst the West Atlantic and Caribbean terebrids but has been rarely recorded. The range of the species is restricted to the northern Caribbean (Florida, Bahamas and Cuba) but Faber (2007: Aruba) and the present finding (Guadeloupe) confirm a much wider range southwards and it probably lives throughout the eastern rim of the Caribbean islands.

Terebra species 2
Fig. 17

The species bears some resemblance to *T. glossema* in the characteristics of the sculpture, but the density of the spiral and axial sculpture is rather different. The sculpture is much coarser and the general outline is much more slender than in *T. glossema*. At present this species is only represented by a single specimen. Thus nothing is known concerning intraspecific variability. The species can not be compared to any other known taxon in the Caribbean and is most probably new to science. Due to the lack of additional specimens at the moment, the species remains under study awaiting more finds.

Terebra species 3
Figs 18-19

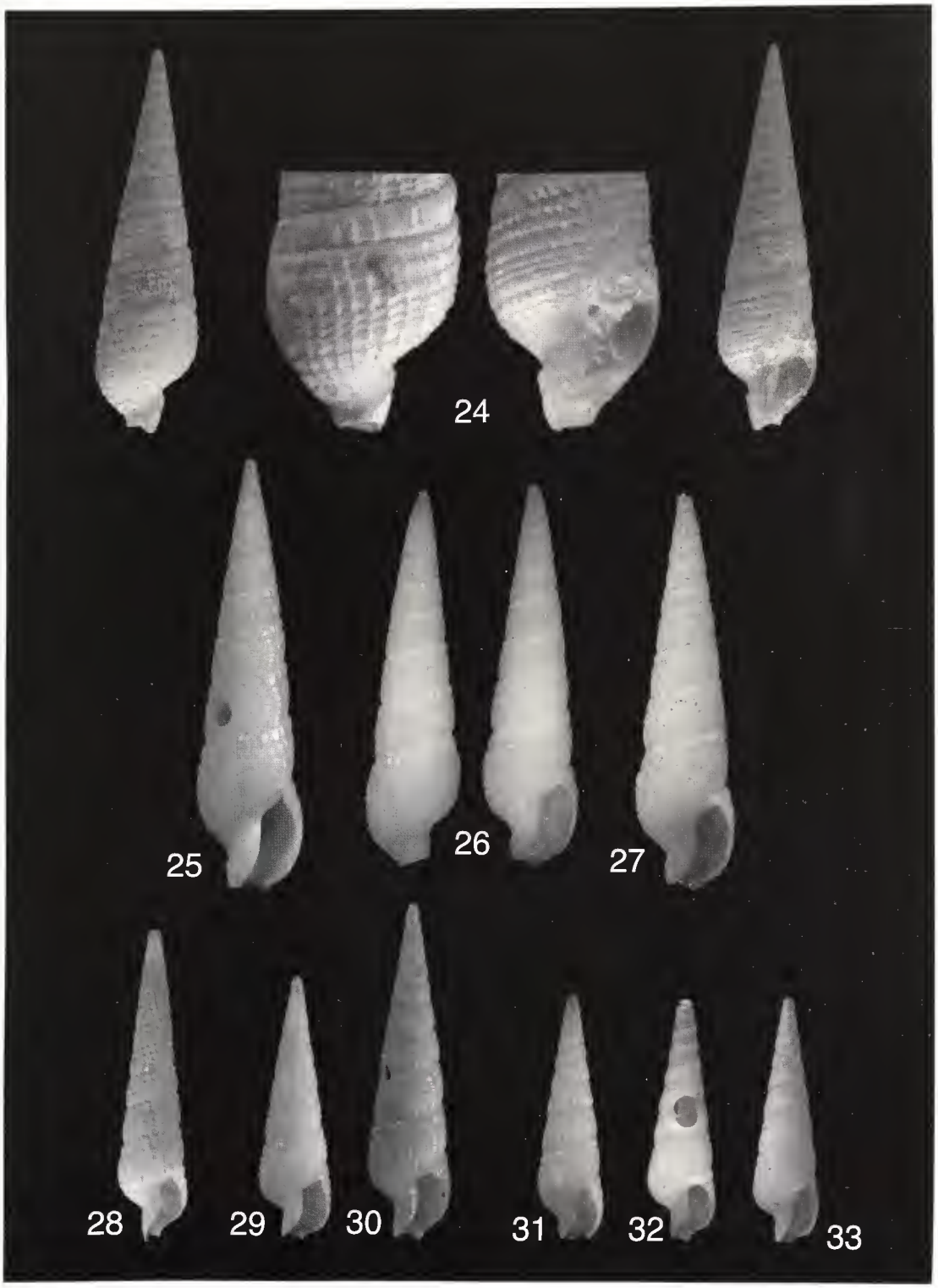
The following three species can obviously be accredited as belonging to the *limatula*-group because of the shell surface morphology, which is reticulated and beaded; but because of constant differences in protoconch and variations in the sculpture, they must be assigned under different taxa.
The spiral sculpture of this species is sharp: deep grooves separated by almost protruding beads, yet close-set and dense.

Terebra species 4
Figs 20-22

The present species was also dredged at the type locality of *Terebra lamyi*. It was preliminary stored as *T.* cf. *colombiensis* pending further research but the present paper proves that it is does not belong to that species nor with any of the related species. The main difference is the conical, paucispiral protoconch of about 2.5-3.0 whorls, *T. limatula* and *T. colombiensis* both have a near-mammillate protoconch. Furthermore the present species is quite distinguishable because the fine beading and deep and wide spiral grooves gave rise to a somewhat step-like or turreted outline of the whorls. Because of the close relationship in sculpture, this species is without doubt related to the aforementioned. It is here figured for the first time awaiting more specimens for further study.

Figures 24-33 (All from coll. Dominique Lamy and from Guadeloupe).

24. *Terebra* species 6. 14.5 mm, off Port-Louis, 130 m.
25-27. *Terebra* species 7. 25. 16.3 mm, off Port-louis, 130 m. 26. 14.3 mm, off Port-Louis, 100 m. 27. 14.8 mm, off Port-Louis, 150 m.
28. *Terebra* species 8. 11.5 mm, off Port-Louis, 160 m.
29-33. *Terebra* species 9. 29. 9.8 mm, off Port-Louis, 100 m. 30. 12.5 mm, off Port-louis 100 m. 31. 9.2 mm, off Port-Louis, 120 m. 32. 6.1 mm, off Port-Louis, 100 m. (x 1.5). 33. 9.1 mm, off Port-Louis, 120 m.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Terebra species 5
Fig. 23

The species shows a strong resemblance to *T. limatula* but again the protoconch and the even coarser general sculpture leaves no doubt that it represents a different and perhaps undescribed taxon.

Terebra species 6
Fig. 24

The species has no comparison in the Caribbean but is somewhat similar in sculpture to a species occuring in the Indo-Pacific (coll. MNHN, Marquesas Islands) currently under study and description. The species is only known from one dead collected specimen which would make description premature at this stage.

Terebra species 7, 8 & 9
Figs 25-33

The mentioned 3 morpho-species are without doubt related and close in resemblance to *T. alba*.
Although *T. alba* is reported throughout the Caribbean, findings are usually restricted to the North (Gulf of Mexico, Bahamas, Florida etc…).
Species 6 & 8 are elosely related to one another and to *T. alba* because of similar sculpture, yet differ amongst each other in protoconch size and shape.
Species 7 has a coarser sculpture and a different protoconch than the aforementioned.

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The *Cantharus* group (Gastropoda: Buccinidae) on Almirante Leite Bank (Mozambique) with description of two new species and one new genus

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ABSTRACT. A new genus and two new species of deep water Buccinidae collected during MAINBAZA are described: *Pollia imprimelata* sp. nov. and *Micrologus mochatinctus* gen. & sp. nov., both from Almirante Leite Bank. *Pollia sowerbyana* (Melvill & Standen, 1903) is recorded from Madagascar and the variability of this species is discussed.

KEYWORDS. Mollusca, Gastropoda, Buccinidae, Pisaniinae, *Pollia*, Mozambique, MAINBAZA, new taxa.

INTRODUCTION. Ignored in the past, the Mozambique fauna has become the subject of intensive collecting and studies during the latest decades. It is obvious that Mozambique is blessed with a unique fauna, with components from the South African fauna as well as from the East African fauna, due to its geographical situation. Ridden up fragments from the deep water faunas are present, from the Natal Bassin (in the south) and the Somalian Bassin (in the north). In addition, a large number of species which are most probably endemic for the regio are known.

The second author participated in the recent MAINBAZA cruise in the Mozambique Channel. Part of the Admirante Leite Bank was investigated during this expedition, an area with strong currents resulting in difficult dredging and trawling conditions. Among many animals two particular species belonging to the *Cantharus* group attracted attention. One is recognized as belonging to an undescribed species of the genus *Pollia* Gray in Sowerby, 1834 and named *Pollia imprimelata* sp. nov. For the second species, which is distinct in spiral sculpture and columellar characteristics from all known *Cantharus* group species, we had to decide to describe a new genus because it seems out of place in any of the other known genera. This taxon is added to the East African fauna under the name *Micrologus mochatinctus* gen. & sp. nov.

Material is, unless otherwise stated, deposited in MNHN. The material is, unless being a type (which are allocated to catalogue numbers), unambiguously designated and retrievable by the combination of expedition acronym and station number.

ABBREVIATIONS

KF: collection Koen Fraussen, Belgium.
MHNM: Museu de Historia Natural de Maputo, Mozambique.
MNHN: Muséum national d'Histoire naturelle, Paris, France.
JR: collection José Rosado, Portugal.
dd: empty shell, dead collected.
juv: juvenile or subadult shell.
DW: (drague Warén) Warén dredge.

SYSTEMATICS

BUCCINIDAE Rafinesque, 1815
Subfamily **Pisaniinae** Gray, 1857

Genus ***Pollia*** Gray in Sowerby, 1834

Pollia, Gray in Sowerby, 1834: pl. 237, fig. 12. Type species by monotypy: "*Triton undosus* Lamk." = *Buccinum undosus* Linnaeus, 1758 from the Indo-West Pacific, Recent.

For a discussion on the taxonomic position of *Pollia* we refer to Vermeij & Bouchet (1998: 472-473) and Vermeij, (2006: 85-86, 89-91).

Pollia imprimelata sp. nov.
Figs 7-11

Type material. Holotype, 19.9 mm, Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3167, 26°12'S, 35°02'E, 228-230 m deep, MNHN-23770.

Paratypes 1-7, 19.1-21.6 mm, same locality, MNHN-23771, MHNM, JR, KF-6129.
Paratype 8, 12.6 mm, juvenile (protoconch), same locality, MNHN-23771.

Type locality. Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3167, 26°12'S, 35°02'E, 228-230 m.

Material examined. Mozambique: Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3167, 26°12'S, 35°02'E, 228-230 m, 28 dd (9 jv.). - Stn DW3169, 26°11'S, 35°01'E, 450 m, 4 dd.

Range and habitat. Only known from the Almirante Leite Bank. Bathymetric range, all empty shells, between 228 and 450 m.
Syntopic with *Micrologus mochatinctus* sp. nov. on Almirante Leite Bank (MAINBAZA stn. DW3167 and DW3169).
Almirante Leite Bank is an area with strong currents overflowing a bottom of hard rocks. The habitat is characterized by the presence of rock, coral, sponges and gorgonians (Text Fig. 1).

Text Figure 1. Habitat of *Pollia imprimelata* sp. nov.

Description. Shell of medium size for genus (up to 21.6 mm in height). Shape semi-oval, spire rather conical. Teleoconch whorls 5 ½ in number, laterally flattened, suprasuturally with narrow, but clearly constricted area. Colour white to yellowish brown with brown spiral lines on top of axial sculpture.
Protoconch consisting of slightly more than 1 ¾ whorl, 2.2 mm high, 1.1 mm in diameter. Colour yellowish with brown spot on tip. Whorls rapidly increasing in size, last whorl big, convex. Surface smooth, rather glossy, but covered with numerous minute shallow holes. Transition to teleoconch marked by 3 or 4 fine incremental lines.
First whorl with 3 well developed primary spiral cords; a fine, fourth cord present in subsutural interspace. A single, fine secondary spiral cord appears along second whorl, situated in the middle of each interspace. Subsutural spiral cord increasing in strength, on third whorl almost as strong as other primary spiral cords; a fifth primary spiral cord partly concealed under suture with subsequent whorl. One subsutural secondary spiral cord becoming as strong as primary spiral cords along penultimate whorl, resulting in the presence of 2 spiral cords on subsutural slope which render a bilirate appearance and form a deep suture above axial ribs. Penultimate

whorl with 5 primary spiral cords, two subsutural ones slightly weaker, separated by a narrower interspace; a sixth primary spiral cord partly concealed under suture of subsequent whorl. Body whorl with about 40 spiral cords of different strength, 20 of them primary and secondary spiral cords of about same strength, alternating with about 20 finer tertiary spiral threads. First teleoconch whorl with 13 fine axial ribs; abapically, on the suprasutural adpression, becoming weaker, resulting in a suture with constricted appearance; interspaces of equal size or slightly broader. Subsequent whorls with 12 axial ribs. Ribs becoming gradually weaker, but slightly broader. Body whorl with 8 axial ribs, about 3 additional ribs, or traces of them, on prelabral varix. Last 1/4 part of body whorl covered with a broad, but weak prelabral varix. Whole surface covered with minute, sharp incremental lamellae.

Aperture oval, adapical part pinched. Columella strongly concave; callus thin, white, rather adherent to preceding whorl, covered with big lirae according to sculpture of preceding whorl, with a single adapical columellar lira and 3 strong, abapical columellar folds near transition to siphonal canal. Outer lip thin; ornamented with about 16 internal lirae of different strength, not according to sculpture of outer surface. Siphonal canal short, broad, open. Aperture and siphonal canal together slightly more than ½ of total shell length.

Animal and operculum unknown.

Comparision. *Pollia imprimelata* sp. nov. is characterized by the laterally slightly flattened whorls which give the spire a more conical appearance and, as a consequence, a more pinched adapical part of the aperture. The maximum diameter of each whorl is situated below the periphery. This shape is rather atypical for the genus.

The colour ranges from snow-white and off-white with some pale brownish bands to the presence of reddish brown spiral lines on top of the spiral sculpture, especially on the periphery and subsutural slope. Snow-white shells and coloured ones were found in the same haul (MAINBAZA stn. DW3167 and DW3169).

All known *Pollia* species differ by having a convex subsutural area and the slightly more rounded adapical part of the outer lip. (See below.)

Pollia sowerbyana (Melvill & Standen, 1903) (type locality: "Gulf of Oman and Mekran Coast, especially between Gwadûr and Jask, from 25-30 fathoms") (Fig. 13) is characterized by the convex, slightly shouldered whorls, the big axial ribs, the round rather than oval aperture with a weak adapical tabulation. The suture is distinct, suprasuturally slightly appressed. Specimens with a broad shape, or short spire, may have the appressed band partly concealed under the next whorl.

Pollia sowerbyana is similar in spiral sculpture, but differs by the convex teleoconch whorls which reach their maximum diameter near the shoulder (instead of below the sutural line), consequently the adapical part of the outer lip is broader and more tabulate where connected with the preceding whorl; the prelabral varix is stronger but narrower; the suprasutural constricted area is usually broader; the subsutural spiral cords are straight (rather than waved or twisted where crossing the axial ribs) and finer with a broader interspace; the number of axial ribs is smaller on the upper teleoconch whorls (about 10) but higher on the body whorl (10 including the prelabral varix); the columellar callus is broader, especially the adapical part which has a gently curved edge; the pattern usually consists of 2 broad bands (instead of fine lines) and it seems that the hairs on the periostracum are longer.

It may be possible that the more eastern species (Philippines: *P. vicdani*; Coral Sea and New Caledonia: *P. pellita*) have to be regarded as conspecific with *P. sowerbyana*. Further study may throw a light on this question but in the meantime we regard these taxa as distinct (see below).

Pollia vicdani (Kosuge, 1984) (type locality: Philippines, Bohol, off Panglao, 120 fms.) is similar, but differs from *P. imprimelata* sp. nov. by the bigger number of axial ribs on the body whorl (the number of axial ribs on the upper spire whorls is the same) and the slightly more convex subsutural area and the slightly more rounded adapical part of the outer lip. The number of axial ribs on penultimate and body whorls seems to vary considerably in many *Pollia* species, but it is quite constant in Philippine populations of *P. vicdani*. We doubt this is a solid characteristic to distinguish these species or forms.

Pollia pellita Vermeij & Bouchet, 1998 (type locality: New Caledonia, Loyalty Ridge, 20°42'S, 167°00'E, 270 m) is similar to *P. imprimelata* sp. nov. in shape and pattern, especially the form from Coral Sea, but differs by the slightly more convex subsutural area and the slightly more rounded adapical part of the outer lip.

Pollia delicata (E. A. Smith, 1899) (type locality: Investigator "Station 237, lat. 13° 17' N., long. 93° 7' E., off Andaman Islands, 90 fath.") is similar, but differs from *P. imprimelata* sp. nov. by the smaller number of protoconch whorls (about 1), the clearly more convex whorls, the spiral sculpture which is fine and running straight near the subsutural slope (instead of being twisted when crossing the axial ribs).

Etymology. *Pollia imprimelata* sp. nov. is derived from *imprimere* (Latin, verb) meaning "press upon" in combination with *latus* (Latin) meaning "side", which refers to the slightly flattened lateral sides. The last letters of *imprimere* are contracted to avoid deviating pronunciation.

***Pollia* sp.**
Fig. 12

Material. Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3168, 26°12'S, 35°03'E, 87-90 m, 1 dd.

Remarks. The single dead collected specimen has a slightly damaged columellar part of the siphonal canal and is characterized by the protoconch which consist of a single whorl with a rather broad, but slightly flattened tip.

The shell is similar to *Pollia imprimelata* sp. nov. in spiral sculpture, but differs by the protoconch which consist of a single whorl (instead of 2 whorls) with a flattened tip, the more convex whorls resulting in a more convex adapical part of the aperture and a shape typical of the genus, the adapical part of the axial ribs which is weaker and the smaller adult size.

Pollia subcostata (Krauss, 1848) (type locality "In litore natalensi": South Africa, Natal, littoral), a species which also lives along the coast of Madagascar and Mozambique in shallow to fairly deep water, is easily distinguishable by the bigger spiral cords and by the body whorl with weak or absent axial sculpture. *P. subcostata* also has a thicker shell, a darker colour and a thick periostracum, but these three features may vary in the genus, according to bathymetric occurrence.

Micrologus gen. nov.

Type species. *Micrologus mochatinctus* sp. nov. (type locality: Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3169, 26°11'S, 35°01'E, 450 m deep).

Diagnosis. Shell rather small. Shape semi-oval; spire moderately high, fusiform; base slightly stretched. Protoconch paucispiral, consisting of about 1 smooth whorl; surface rather rough, covered with minute shallow holes. Transition to teleoconch indistinct, marked by the start of the sculpture of the teleoconch. Spiral sculpture fine, consisting of thin primary spiral cords (4 on first whorl, 5 on other spire whorls, 11 on body whorl). Spiral interspaces broad on periphery, with 1 (on upper spire whorls) to 3 (on fourth whorl to body whorl) fine secondary spiral threads of equal strength, occasionally 4.

Axial sculpture consisting of broad ribs with broad interspaces, running from suture to suture on spire whorls, from suture to just below midwhorl on body whorl.

Aperture large, ovate, adapically slightly pinched with a single columellar knob and a labral knob bordering the anal notch. Columella strongly concave, smooth and glossy, with an adapical columellar knob (bordering the anal notch) and a strong abapical columellar knob on transition to siphonal canal. Callus thin, smooth, glossy, broad; abapical part more developed, forming a broad layer well adherent to columella. Outer lip rounded, lip thick, edge sharp, with broad, but low internal knobs, not situated according to primary spiral cords on outer side; adapical knob slightly bigger, occasionally split; abapical knob slightly bigger, on transition to siphonal canal. This abapical knob not situated in front of abapical columellar knob but strongly diagonally orientated to each other. Labral varix low but broad, slightly prosocline. Siphonal canal short, broad, open.

Comparison. The diagnosis is based on the single known species, described below. Therefore we do not know the magnitude of variation within the genus. Based on known variability in other genera of the *Cantharus* group we may assume with some certainty that the way the spiral cords are arranged is a solid diagnostic feature, as well as the convex shape of the teleoconch whorls and the narrow siphonal area without constricted base. Contrary to the strength of the primary spiral cords, the width/length index and the size are features variable in most other related genera.

Hesperisternia Gardner, 1944 (type species: *Hersperisternia waltonia* Gardner, 1944: 445-447, from the Miocene of Florida), has a similar sculpture consisting of fine spiral cords and a columellar fold on the transition to the siphonal canal. The strongly sculptured species of that genus look much different at first glance, but the more subtly sculptured species like *H. multangula grandanus* (Abbott, 1986) and *H. shaskyi* (Berry, 1959) have a similar spiral sculpture consisting of a few primary spiral cords with many fine secondary spiral threads of equal strength in the interspaces. *Hesperisternia* species differ from the new genus by the presence of 3 dominant spiral cords on the periphery (while in *Micrologus* gen. nov. all primary spiral cords, also on the base, are of a rather equal strength); the secondary spiral cords of unequal strength, the decreasing number of axial ribs towards the body whorl; the presence of well developed sculpture in the aperture and the shorter, slightly twisted siphonal canal with a slightly more pronounced umbilical fissure and a slightly more constricted area between base and siphonal canal.

Hesperisternia waltonia Gardner, 1944 (type locality: "No. 3742, Shell Bluff, Shoal River, Walton County, Florida"), the type species of the genus, is described with 3 protoconch whorls while Recent species of that genus have 1 to 1 ¾ protoconch whorls.

Hesperisternia shaskyi (Berry, 1959) (type locality: south off Guaymas, Sonora), which is in fact not a typical species of its genus, is ornamented with a spiral sculpture most similar to *Micrologus* gen. nov. (evenly spaced primary spiral cords, secondary spiral cords of more or less equal strength) and a weakly sculptured aperture, but differs (apart from the broad shape and distinct range) by the more constricted shape of the base, the shorter siphonal canal and by the broad spiral cords on the siphonal canal.

The range of *Hesperisternia* is restricted to East Pacific and West Atlantic warm waters (at present no Indo-West Pacific species are known) while *Micrologus* gen. nov. is known from eastern Africa which is the other side of the planet).

For a detailed account on the fossil and recent *Hesperisternia* species we refer to Vermeij (2006: 81-82, 89-91).

Pollia Gray in Sowerby, 1834 (type species: *Buccinum undosum* Linnaeus, 1758: 740) may look similar in shape and size, but differs by the spiral sculpture consisting of cords of a rather irregular strength, the more oval shape with shorter siphonal canal and the presence of sculpture on the columella.

Cancellopollia Vermeij & Bouchet, 1998 (type species: *Cancellopollia gracilis* Vermeij & Bouchet, 1998: 480-483) differs by the more oval shape and the bigger spiral cords of unequal strength.

Species with a similar columellar callus, for example *Pollia shepstonensis* Tomlin, 1926, *Buccinum cinis* Reeve, 1846 and *Triton egregia* Reeve, 1844, all of uncertain generic placement (often placed in *Engina* J. E. Gray, 1839 or *Prodotia* Dall, 1924), may look similar in size, shape and colour, but differ by the broader spiral cords, especially on the base and by the presence of knobs or lirae on the columella.

Etymology. *Micrologus* gen. nov. is named after the book "Micrologus", written in 1026 by Guido d'Arezzo and one of the two most popular books about music in medieval times. The musical notation (staff notation) introduced in that work is still used nowadays. The name refers to the fine spiral lines of the shell, which are 5 in number when counting the secondary spiral threads and adjacent primary spiral cords, which is similar to, and the same number of the staff notation. This sculpture is also present on the base of the shell, contrary to other known genera in the group, but similar to the ensemble of staffs on a score.

Micrologus mochatinctus sp. nov.
Figs 1-6

Type material. Holotype, 15.0 mm, Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3169, 26°11'S, 35°01'E, 450 deep, MNHN-23772.
Paratype 1, 9.5 mm, juvenile (protoconch), same locality, MNHN-23773.
Paratypes 2-5, 13.4-13.8 mm, same locality, MNHN-23773, MHNM, JR, KF-6130.

Type locality. Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3169, 26°11'S, 35°01'E, 450 m deep.
Material examined. Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3167, 26°12'S, 35°02'E, 228-230 m, 5 dd (1 fragment). - Stn DW3169, 26°11'S, 35°01'E, 450 m, 8 dd (1 juv., 4 fragments).

Range and habitat. Only known from Almirante Leite Bank. Bathymetric range, all empty shells, between 228 and 450 m.
Syntopic with *Pollia imprimelatus* sp. nov. on both DW3167 and DW3169 stations.
Almirante Leite Bank is an area with strong currents overflowing a bottom of hard rocks. The habitat is characterized by the presence of rock, coral, sponges and gorgonians (Text Fig. 1).

Description. Shell small (up to 15.0 mm). Shape semi-oval, spire fusiform, base slightly stretched. Axial sculpture dominant in combination with accentuated spiral pattern. Protoconch paucispiral, consisting of about 1 smooth whorl with rather rough surface. Transition to teleoconch indistinct, marked by a fine incremental line and the start of the sculpture of the teleoconch. Teleoconch with 5 ¼ whorls. Colour white with brown spiral bands; upper spire whorls white, with small brown dots on axial ribs in between spiral cords; spiral interspaces of lower spire whorls and body whorl ornamented with broad, chocolate brown spiral bands, usually darker on axial ribs, secondary spiral threads usually brown, primary spiral cords snow-white. Narrow band along subsutural slope and tip of siphonal canal snow-white.
First teleoconch whorl with 4 fine spiral cords, 2 subsutural ones slightly finer, interspaces of equal size. Second whorl with 5 primary spiral cords, abapical one rather big, gradually decreasing in strength towards upper suture, adapical spiral cord finer. Third whorl with a single fine secondary spiral thread (holotype) or cord (paratype 1) in the middle of each spiral interspace. Spiral interspaces gradually becoming broader, at first on periphery; number of secondary spiral threads increasing to 3 on fourth whorl and body whorl. Spiral sculpture fine, of equal strength along the whorl, occasionally slightly higher when crossing axial ribs; primary spiral cords evenly spaced also on base, slightly narrower on subsutural slope; secondary spiral threads of equal strength.
First teleoconch whorl with 11 narrow axial ribs; abapically slightly weaker or ended, resulting in a rather constricted suture; interspaces broad. Axial ribs gradually becoming broader, their number slightly increasing to 10 on second whorl, 9 on third whorl. Penultimate whorl with 11 axial ribs, body whorl with 13 ribs, including prelabral varix. Axial ribs running from suture to just below periphery on body whorl.
Aperture large, ovate, adapically slightly pinched with a single columellar knob and a labral knob bordering the anal notch. Columella concave, smooth and glossy, with an adapical columellar knob (bordering the anal notch) and a strong abapical columellar knob on transition to siphonal canal. Callus thin, smooth, glossy, broad; abapical part more developed, forming a broad layer well adherent to columella. Outer lip

rounded, lip thick, edge sharp, with broad but low internal knobs, not situated according to primary spiral cords on outer side; adapical knob slightly bigger, occasionally split; abapical knob slightly bigger, on transition to siphonal canal. This abapical knob is not situated in front of the abapical columellar knob, but strongly diagonally orientated abapically of it. Labral varix low but broad, slightly prosocline. Siphonal canal short, broad, open.
Animal and operculum unknown.

Comparison. *Micrologus mochatinctus* sp. nov. is characterized by the fine spiral sculpture consisting of equally spaced primary spiral ribs of equal strength with the interspaces ornamented with 3 (occasionally 4) fine secondary spiral threads of equal strength, in combination with a smooth columella.

All possibly similar species of other groups differ by the presence of stronger spiral cords on the base and by the presence of knobs and lirae on the columella.

Etymology. *Micrologus mochatinctus* sp. nov. is derived from "mocha", originally Mocha in Yemen where coffee has been exported since ancient times, now used for a mixture of coffee and chocolate, and for expressing the brown colour; in combination with "tinctus" (Latin), meaning "a dye".

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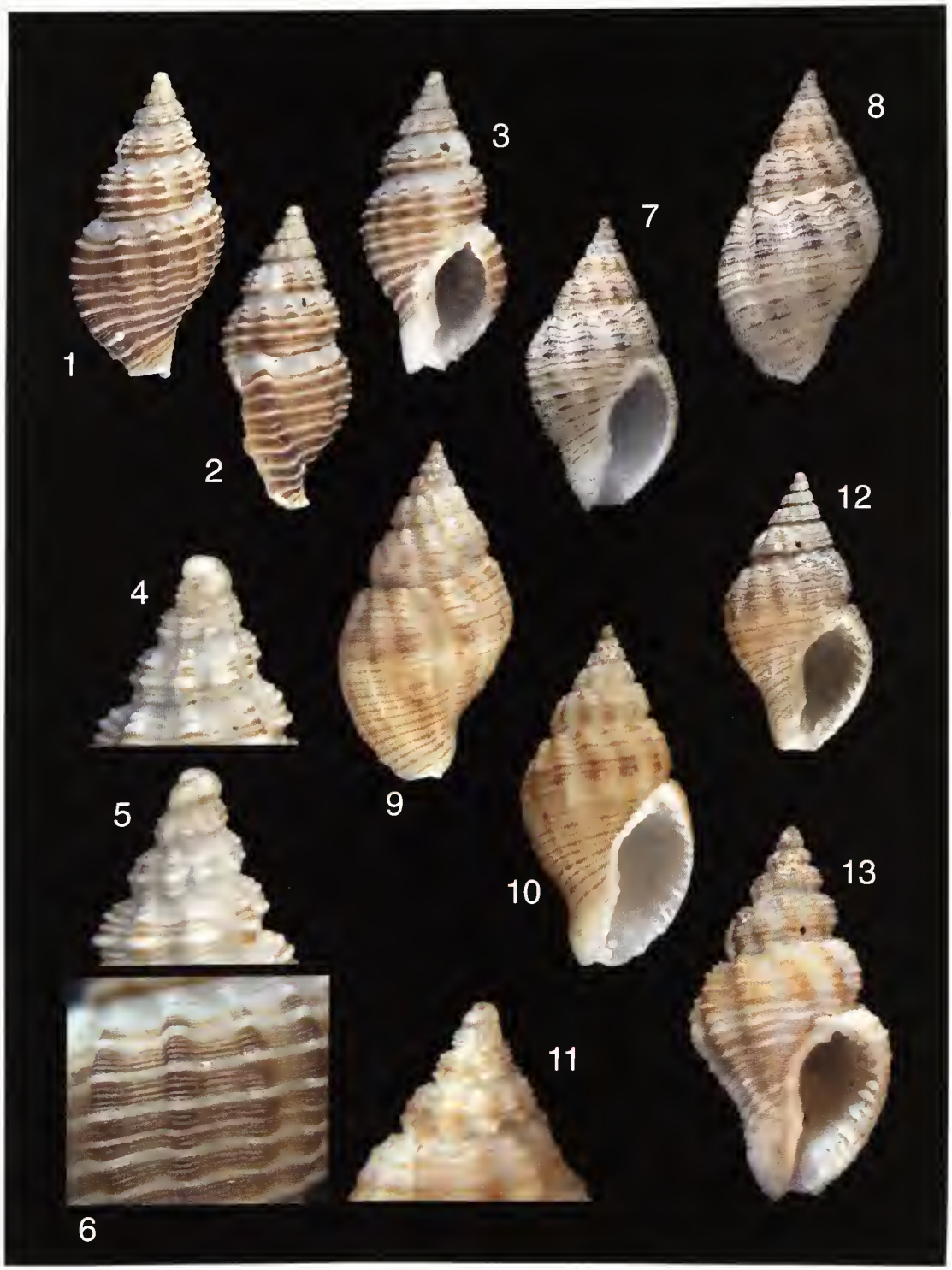
Figures 1-13

1-6. *Micrologus mochatinctus* gen. & sp. nov., holotype MNHN-23772, 15.0 mm, Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3169, 26°11'S, 35°01'E, 450 m deep.
7-11. *Pollia imprimelata* sp. nov.
7-8. Holotype MNHN-23770, 19.9 mm, Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3167, 26°12'S, 35°02'E, 228-230 m deep; **9-10.** Paratype 1, MNHN-23771, 21.3 mm, same locality;
11. Protoconch of paratype 8, MNHN-23771, diameter 1.1 mm, same locality.
12. *Pollia* sp., 17.6 mm, Mozambique Channel, Almirante Leite Bank, MAINBAZA stn. DW3168, 26°12'S, 35°03'E, 87-90 m deep, MNHN.
13. *Pollia sowerbyana* (Melvill & Standen, 1903), northwestern Madagascar, between Majunga and Cape St. André, MIRIKY stn CP3260, 15°35'S, 45°45'E, 179-193 m deep, MNHN.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Nomenclatural notes on *Amaea arabica* (Nyst, 1871) *comb. nov.* and *Cirsotrema fimbriolatum* (Melvill, 1897) (Gastropoda: Epitoniidae), two similar species from the Indo-Pacific faunal province

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KEYWORDS. Gastropoda, Epitoniidae, *Amaea*, *Cirsotrema*, nomenclature.

ABSTRACT. *Scalaria decussata* 'Lamarck' Kiener, 1838, and *S. decussata* 'Lamarck' Sowerby II, 1844, are shown to refer to a Recent species different from the true *S. decussata* Lamarck, 1804, a fossil. The illustration of the holotype of *Scalaria arabica* Nyst, 1871, is compared to photographs of the probable holotype of *Cirsotrema kieneri* Tapparone-Canefri, 1876, to document that the two species are conspecific, that Nyst's name has precedence, and that *S. arabica* belongs to the genus *Amaea*. *Scalaria fimbriolata* Melvill, 1897, a similar species from the Indo-Pacific faunal province that has been confused with *A. arabica*, is shown to be specifically and generically distinct from *A. arabica*.

INTRODUCTION

A review of the literature on the Epitoniidae, e. g. Nakayama (2003: 21) illustrates that questions exist regarding the relationship between *Scalaria decussata* Lamarck, 1804, an Eocene fossil species collected near Paris, France, and the Recent species *Scalaria arabica* Nyst, 1871 [= *Scalaria decussata* Lamarck *sensu* Sowerby II (1844: 103, pl. 35, fig. 140)] and *Cirsotrema kieneri* Tapparone-Canefri, 1876 [=*Scalaria decussata* Lamarck *sensu* Kiener (1838: 21, pl. 7, fig. 23)].

To resolve these questions, we set out to track down photographs of the type specimens of *S. decussata*, *S. arabica*, and *C. kieneri* and also conducted a thorough review of the literature that included references to these species names. In the course of our research, we discovered that the species listed above have also been confused with the species described under the name *Scalaria fimbriolata* Melvill, 1897, a similar Recent species referable to the genus *Cirsotrema*. Therefore, in addition to documenting our conclusion that the correct name for the species illustrated by Kiener and Sowerby is *Amaea arabica* (Nyst, 1871), we have included a discussion of Melvill's species to document that it is not a synonym of *A. arabica*.

Abbreviations

NHMUK: Natural History Museum, London.
MHNG: Muséum d'Histoire Naturelle de Genève.
dd: specimen(s) collected dead.
lv: specimen(s) collected alive.

SYSTEMATICS

Family **EPITONIIDAE** S. S. Berry, 1910
Genus ***Amaea*** H. & A. Adams, 1853: 223
Type species: *Scalaria magnifica* G. B. Sowerby II, 1844, by subsequent designation (Boury, 1909: 258)

Amaea decussata (Lamarck, 1804)
Fig 1-2

Scalaria decussata Lamarck, 1804: 213; Lamarck, 1806: pl. 10, fig. 3; Lamarck, 1822: 229; MHNG, 1918: pl. 6, figs. 74 a, b, 75 a, b; non *Scalaria decussata* Pease, 1867: 289 [=*Epitonium sandwichense* (Nyst, 1871)].

Distribution. France. Fossil, Eocene.

Remarks. The original engravings of Lamarck's *S. decussata* (Lamarck, 1806) show both spiral and axial sculpture, though the axial sculpture overlays the spiral. Photographs of the syntypes of Lamarck's *S. decussata* published by the MHNG (1918) show that this fossil species has convex teleoconch whorls that are not angular below the suture and the axial costae are not raised where they cross the spiral cords (Fig. 1-2). The sculpture indicates that the species is correctly placed in the genus *Amaea*.

Pease (1867: 289) also named a *Scalaria decussata*. Pease's shell, however, is an *Epitonium* and the name was also replaced by Nyst (1871: 132) with *Scalaria sandwichensis*.

***Amaea arabica* (Nyst, 1871)**
Figs 3-7, 11

Scalaria decussata Kiener, 1838: 21, pl. 7, fig. 23; Sowerby II, 1844: 103, pl. 35, fig. 140; Sowerby II, 1874: species 114, pl. 15, fig. 114a; Clessin, 1897: 39, pl. 12, fig. 2.; non *Scalaria decussata* Lamarck, 1804.
Scalaria arabica Nyst, 1871: 105; Boury, n.d., pl. 35, fig. 1, 3. *Nom. nov.* for *Scalaria decussata* Sow. (non Lam.). Type locality: coast of Arabia.
Cirsotrema Kieneri Tapparone-Canefri, 1876: 155; Kaicher, 1983: 3584. *Nom. nov.* for *Scalaria decussata* Kiener (non. Lam.). Type locality: none given.
Amaea Sowerbyi Dunker, 1882: 69; *nom. nov.* for *Scalaria decussata* Sow. (non Lam.)
Scalaria kieneri: Tryon, 1887: 81, pl. 17, fig. 21, 22, 26.
Amaea decussata: Cleevely, 1980: 240, fig. 2, 7.
Amaea (*Amaea*) *decussata*: Weil, *et. al.*, 1999: 82, fig. 234.

Material Examined. Urangan, south Queensland, Australia, 2 dd. Palandra Beach, Townsville, Queensland, Australia, 1dd. Swan Reefs, Queensland, Australia, trawled, 1dd.

Distribution. Red Sea, south to Mauritius, east to Queensland, Australia. Intertidal to 15 m.

Remarks. In their respective monographs of the genus *Scalaria*, Kiener (1838) and Sowerby II (1844) each illustrated species labeled *Scalaria decussata* Lamarck. Nyst, in his *Tableau Synoptique et Synonymique* (the "*Tableau*") presented at the December 3, 1871, meeting of the Société Malacologique de Belgique, erected the replacement name *Scalaria arabica* for the species illustrated by Sowerby. Apparently, Nyst concluded that the species illustrated by Sowerby was not the same as Lamarck's fossil species. Tapparone-Canefri (1876) erected the replacement name *Cirsotrema kieneri* for the species illustrated by Kiener because it was his opinion that Kiener's species was distinguishable from both *S. decussata* Lamarck, 1804, and *S. decussata sensu* Sowerby II, 1844. Dunker (1882) also recognized that Sowerby's species differed from Lamarck's and erected the replacement name *Amaea Sowerbyi*, which is a junior objective synonym of *Scalaria arabica* Nyst, 1871. While Tryon (1887: 81) agreed that the species illustrated by Kiener was distinct from Lamarck's fossil species, he went on to say that in his opinion, Kiener and Sowerby illustrated the same Recent species. Tryon, who apparently overlooked the replacement name erected by Nyst, used the name *Scalaria kieneri* for this species. Cleevely (1980: 240) commented that the species labeled *Amaea decussata* in his paper is virtually indistinguishable from '*Cirsotrema*' *kieneri*, documenting that there were not only questions regarding a possible synonymy at the species level, but also questions regarding the correct generic assignment of this species.

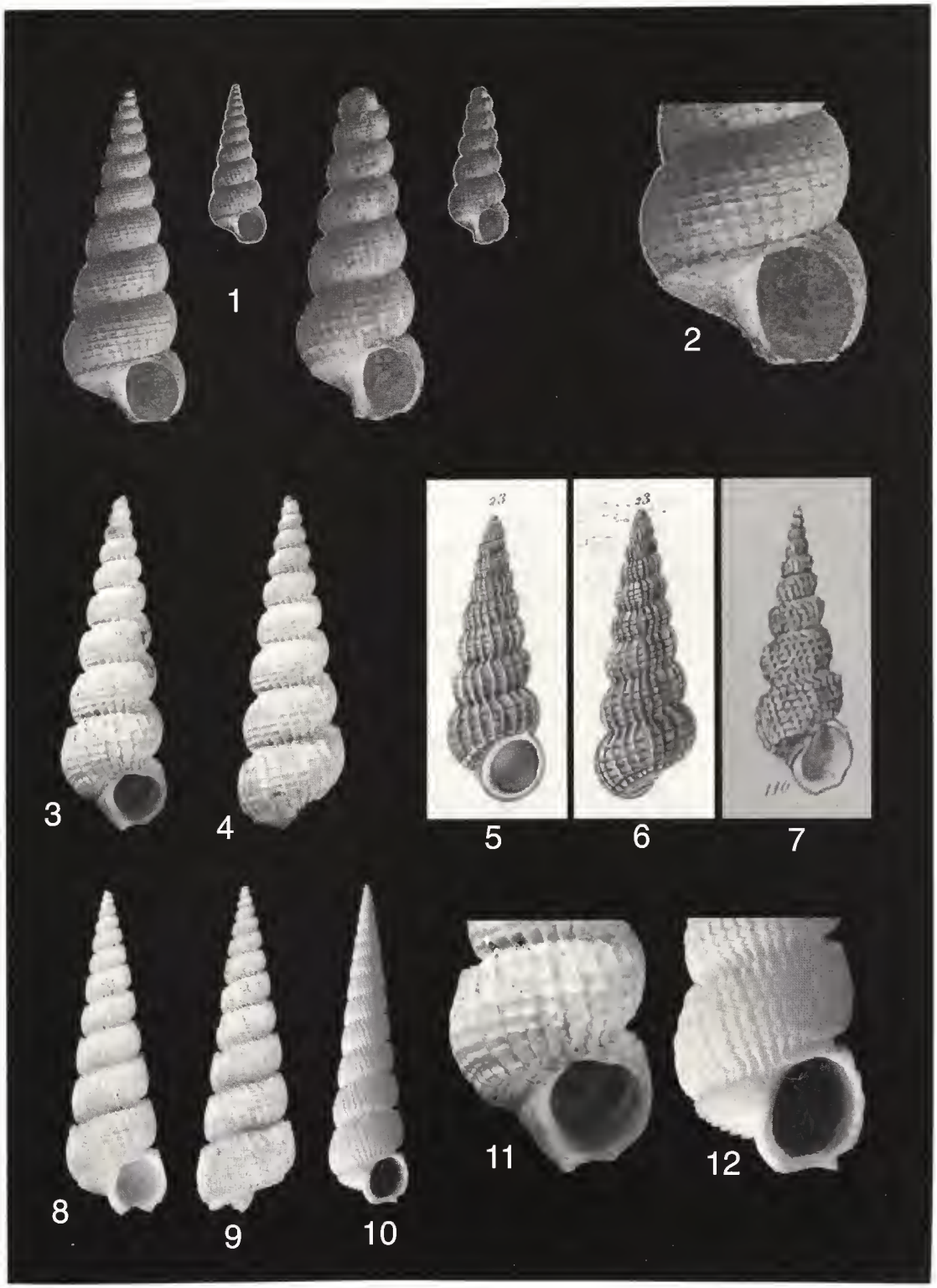
Because Nyst erected the replacement name *S. arabica* based on the specimen figured by Sowerby under the name *S. decussata*, Sowerby's figured specimen is the holotype of *S. arabica* (ICZN, 1999: Art. 72.7). Kathie Way at NHMUK has informed us that the specimen from Arabia figured by Sowerby under the name *Scalaria decussata* is supposed to be in the collection at her institution. She was, however, unable to locate it. We have therefore reproduced an enlarged illustration of Sowerby's figure (Fig. 7).

Similarly, because Tapparone-Canefri erected the replacement name *C. kieneri* for the specimen figured by Kiener under the name *S. decussata*, Kiener's specimen is the holotype of *C. kieneri*. We have reproduced Kiener's figures (Fig. 5-6). Kiener noted that the figured specimen is in "the Museum collection." Kiener's material, which presumably included this specimen, was acquired by Delessert and is now in the collection at the MHNG (Y. Finet pers. comm.). Yves Finet provided photographs of the sole specimen of *Scalaria decussata* in the Delessert collection (Fig. 3-4). Because it matches well, and is consistent in size with, the specimen figured by Kiener, we consider this specimen to be the probable holotype of *Scalaria decussata* Kiener, 1838, and, by extension, *Cirsotrema kieneri*.

Comparison of these figures confirms that the species figured by Kiener is conspecific with the species figured by Sowerby. Both specimens have the same angular teleoconch whorls with cancellate sculpture and the basal ridge and the sculpture on the base of the shell appears to be the same. Because of the combination of the cancellate sculpture on the convex teleoconch whorls, the occasional varices, and the strong basal ridge, we consider this taxon to be referable to the genus *Amaea*.

Figures 1-12

1-2. *Scalaria decussata* Lamarck, 1804, MHNG, syntypes, photo of Fig 74 & 75 in *Catalogue illustré de la Collection Lamarck. Mollusques Trachélipodes Fossiles*, with permission. **3-4, 11.** *Scalaria decussata* Lamarck, *sensu* Kiener, 1838, length 40 mm, no locality data, MNHG 67919, probable holotype of *Cirsotrema kieneri* Tapparone-Canefri, 1876. **5-6.** *Scalaria decussata* Lamarck, *sensu* Kiener, 1838 (Kiener's figure). **7.** *Scalaria decussata* Lamarck, *sensu* Sowerby II, 1844 (Sowerby's figure), holotype of *Scalaria arabica* Nyst, 1871. **8-9.** *Scalaria fimbriolata* Melvill, 1897, length 19 mm, width 5 mm, Karachi, NHMUK 1897.7.30.90. (holotype). **10, 12.** *Cirsotrema fimbriolatum* (Melvill, 1897), length 59.6 mm, width 14.5 mm, Broome, Western Australia, 15 m, B. Neville coll. no. 1256.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Therefore, Tryon and Tapparone-Canefri were correct in concluding that the Recent species figured by Kiener and Sowerby is not synonymous with the fossil species *S. decussata* Lamarck, 1804, because *S. decussata* has a different sculpture that is evident in the photographs of the syntypes.

Finally, in the course of preparing this manuscript, we discovered there is a question regarding the publication date of Nyst's *Tableau*, which included his replacement name *S. arabica*, as well as replacement names for a number of other epitoniid taxa. While it has generally been given as 1871, the actual publication date could be as late as 1874. The World Register of Marine Species (WoRMS) database gives the date of *Elegantiscala arabica* as 1872, though the source of the date is "not documented." Nyst's other names from the *Tableau* are cited in WoRMS as 1871. Nakayama (2003: 21) gives the date of *Scalaria arabica* as 1873, citing Boury (1913). This is evidently a typographical error on Nakayama's part, however, as Boury (1913: 103) clearly gives 1871 as the date for the *Tableau*; Nakayama (2003: 94) in his own bibliography gives the date of the *Tableau* as 1871. Because the *Tableau* was presented at a December 3, 1871, meeting, we question whether it would have been published that same year. When we checked the *Zoological Record*, we discovered that Nyst's *Tableau* appeared for the first time in the 1874 volume, although it was listed with an 1871 date. While not definitive, it is an indication that the *Tableau* was published after 1871 and certainly no later than 1874. Buckhuys (1985) prepared a bibliographic note on the journals published by the Société Malacologique de Belgique. However, he began with the volume for 1872 and did not provide information on individual publication dates. Because we were unable to resolve this publication date question, we are following earlier authors in using an 1871 publication date for the *Tableau*.

Notwithstanding the uncertainty regarding the publication date, since it is clear that Nyst's *Tableau* was published prior to Tapparone-Canefri's 1876 paper proposing the name *C. kieneri* for this Recent species, there is no question that the oldest available, and valid, name for the Recent taxon is therefore Nyst's replacement name, *Amaea arabica* (Nyst, 1871).

Genus ***Cirsotrema*** Mörch, 1852: 49
Type species: *Scalaria varicosa* Lamarck, 1822, by monotypy.

Cirsotrema fimbriolatum **(Melvill, 1897)**
Figs 8-10, 12

Scalaria fimbriolata Melvill, 1897: 11, pl. 6, fig. 10; Melvill, 1898: 2, pl. 1, fig. 12. Type locality: Karachi.
Scala (*Cirsotrema*) *fimbriolata*: Melvill and Standen, 1903: 349.
Cirsotrema kieneri: Wilson, 1993: 274, pl. 44, fig. 3; Weil, *et. al.* 1999: 128, fig. 401 (non Tapparone-Canefri, 1876).
Epitonium fimbriolatum: Bosch and Bosch, 1982: 52.
Amaea fimbriolata: Bosch, Dance, Moolenbeek, *et. al.*, 1995: species no. 400.
Amaea (*Scalina*) *kieneri*: Nakayama, 2003: 21, pl. 20, fig. 1-3 (non Tapparone-Canefri, 1876).

Material Examined. Off Hervey Bay, Queensland, Australia, 61-79 m, 1 dd. Urangan, south Queensland, Australia, 1 dd. Broome, Western Australia, 15 m, 1 lv. 80 Mile Beach, Western Australia, 1 lv.

Distribution. Gulf of Oman and Persian Gulf, east to Japan and Queensland, Australia. Intertidal to 79 m.

Remarks. *Cirsotrema fimbriolatum* has also been confused with *A. arabica*, but differs from it markedly in structure, indeed belonging to a different genus. The original figures of *Scalaria fimbriolata* (Melvill, 1897, and particularly Melvill, 1898) illustrate particularly well the characters of this species. Unfortunately the quality of the original image is not suitable for enlargement and reproduction here.

While it is superficially similar to *A. arabica*, this species can be distinguished by the characteristic *Cirsotrema* costae and the base of the shell. The base of *C. fimbriolatum* is ringed by a series of triangular projections resembling teeth on a cog, whereas *A. arabica* has a simple basal ridge lacking these triangular projections (Fig. 11, 12).

Scalaria fimbriolata is referable to the genus *Cirsotrema* because of the combination of the strong basal disk, spiral lirae, and the strongly crispate costae that consist of numerous plates that are fused together. This combination of teleoconch characters is present in *Cirsotrema varicosum* (Lamarck, 1822) and a number of other species that have been referred to the genus *Cirsotrema s.s.* Species in the genus *Amaea* can have similar teleoconch scupture, but lack the crispate costae consisting of numerous fused plates.

ACKNOWLEDGMENTS

We want to thank Yves Finet at the MHNG, Geneva, Switzerland, who furnished the photographs of the specimen of *S. decussata* (*sensu* Kiener) in the Delessert collection and authorized us to reproduce the figured specimens of *S. decussata* Lamarck in this manuscript. We also want to thank Kathie Way at NHMUK, London, England, who provided information on the holotype of *S. arabica* and furnished the photographs of the holotype of *S. fimbriolata*. Henry Domke photographed the illustrated specimen in the Bruce Neville collection. Alan J. Kohn of University of Washington Biology provided excerpts of the catalog of Lamarck's types. Emilio García called our attention to the question of the dates of Nyst's *Tableau*, and Paul Callomon at the

Academy of Natural Sciences, Philadelphia and Richard E. Petit provided helpful comments on this question. Lawrence Gall of the Peabody Museum of Natural History, Yale University, prepared the plate.

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Description de *Terebra niauensis* n. sp. (Mollusca: Gastropoda: Terebridae) du Pléistocène de Niau, Tuamotu (Polynésie Française)

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MOTS-CLEFS. Mollusca, Gastropoda, Terebridae, Polynésie Française, Pléistocène

KEYWORDS. Mollusca, Gastropoda, Terebridae, French Polynesia, Pleistocene

RÉSUMÉ. Une nouvelle espèce *Terebra niauensis* n.sp. du Pléistocène est décrite de Niau, Archipel des Tuamotu (Polynésie Française) et est comparée à *Terebra gouldi* Deshayes, 1857, espèce proche actuelle et endémique des Iles Hawaii.

ABSTRACT. *Terebra niauensis* n. sp. is described from Niau, Tuamotu Archipelago (French Polynesia) dated Pleistocene and is compared with *Terebra gouldi* Deshayes, 1857, a quite similar present species endemic to the Hawaiian Islands.

INTRODUCTION

Les tests de *Terebra niauensis* n. sp. proviennent de sables coralliens et coquilliers récoltés sur l'atoll de Niau. L'atoll présente actuellement une altitude de 7,5 m et son lagon saumâtre est sans communication directe avec l'océan et d'une profondeur moyenne de 2 m. Les sables détritiques extraits en bordure du lagon correspondraient à un niveau marin du dernier interglaciaire (Pléistocène, environ 125 000 ans), niveau plus élevé qu'actuellement (de 6 à 10 m) alors que le lagon communiquait avec l'océan. Dans ces sédiments détritiques une autre espèce de mollusque gastropode a été récemment décrite par Tröndlé et Salvat (2010).

Abréviations

BMNH: The Natural History Museum, London, U.K.
CRIOBE: Centre de Recherches Insulaires et Observatoire de l'Environnement, Moorea, Polynésie française.
EPHE: École Pratique des Hautes Études, Perpignan, France.
IRSNB: Institut royal des Sciences naturelles de Belgique.
MNHN: Muséum national d'Histoire naturelle, Paris, France.
AW: Anders Warén, Swedish Museum of Natural History, Stockholm, Sweden.
GK: Gijs Kronenberg, Netherlands.
GP: Gustav Paulay, Florida Museum of Natural History, University of Florida, Gainesville, Florida, USA.
JL: Collection Jean Letourneux.
JT: Collection Jean Tröndlé.
MB: Collection Michel Boutet.
PF: Polynésie Française.

SYSTÉMATIQUE

Famille **TEREBRIDAE** Mörch, 1852
Genre ***Terebra*** Bruguière, 1789
Espèce type: *Buccinum subulatum* Linné, 1767, par monotypie, Lamarck, 1799

Terebra niauensis n. sp.
Figs 1-5, 8, 9

Matériel type. 18 individus; holotype: 96,5 mm, MNHN 23685 (Figs. 1, 2); paratype: 89,5 mm, CRIOBE (Fig. 3, 8, 9); 9 paratypes MNHN 23686: 78 mm (Fig. 4), 81,6 mm, 74 mm, 62,7 mm, 62 mm, 60,4 mm, 55 mm, 50,7 mm et 49,8 mm; paratype 61,2 mm, JT (Fig. 5); paratype 86,1 mm, JL; paratype 84 mm, GP; paratype 79,1 mm, AW; paratype 87,5 mm, (Mairie de Niau); paratype 87,8 mm, MB; paratype 60,6 mm, GK.

Localité type. Atoll de Niau, Tuamotu, Polynésie Française, 16°08'S, 146°20'W.

Description de l'holotype. Coquille d'une hauteur de 96,5 mm, d'aspect brillant et de couleur uniformément blanche; sous UV le test apparaît de teinte ivoire et présente quelques taches brunes sous la suture. La protoconque est absente et la téléoconque compte 14 tours. Les tours sont légèrement convexes. La bande sous-suturale est délimitée par une suture profonde et un sillon sous-sutural bien marqué; elle est ornée de petits nodules, 12 sur le dernier tour, en forme d'accent grave occupant toute la bande sur les premiers tours puis plus espacés et se détachant sensiblement de la suture sur les tours suivants. L'espace entre ces nodules est orné de fines stries axiales occupant toute la hauteur de la bande sous-suturale. Les tours sont sculptés de très nombreuses côtes axiales, anguleuses sur les premiers tours et d'épaisseur variable; ces côtes sont dans le prolongement des stries et des nodules de la bande sous-suturale. La sculpture axiale est obsolescente en avant des derniers tours et sur le dernier tour. Absence de sculpture spirale. L'avant dernier tour présente un orifice circulaire de 5 mm de diamètre, empreinte d'un prédateur. Le dernier tour et l'ouverture sont allongés. Le diamètre du dernier tour est de 20 mm et la hauteur de l'ouverture de 24 mm. La lèvre est fine. La columelle est légèrement convexe, oblique et présente un pli médian.

Distribution. Uniquement connue de la localité type.

Remarques. La taille maximum observée est celle de l'holotype. La protoconque est absente chez tous les exemplaires examinés. L'espace entre les nodules de la bande sous-suturale et leur nombre (de 12 à 20) sur le dernier tour sont variables. Quatorze des dix-huit exemplaires examinés présentent une perforation circulaire, témoin de la présence de prédateurs dans le même habitat. Ces perforations régulières, plus larges à l'entrée qu'au fond sont typiques de celles occasionnées par les Naticidae (Cernohorsky, 1971). *Notocochlis gualteriana* (Récluz, 1844) et *Polinices tumidus* (Swainson, 1840), présents en grand nombre dans les sédiments étudiés de la thanatocénose, sont probablement ces prédateurs.

Terebra niauensis n. sp. est proche de *Terebra gouldi* Deshayes, 1857 (Figs 6, 7) par sa taille et son aspect général. Elle en diffère par sa sculpture axiale plus irrégulière au niveau de la bande sous-suturale et plus fine au niveau des tours. Cette sculpture tend à être obsolescente sur les derniers tours alors qu'elle reste constante et bien marquée chez *T. gouldi*. Le dernier tour et l'ouverture de *T. niauensis* sont nettement plus allongés. L'observation sous UV n'a mis en évidence que quelques taches sous la suture alors que le test de *T. gouldi* est orné de maculations régulières sur la bande sous-suturale et de deux bandes brunes sur le dernier tour.

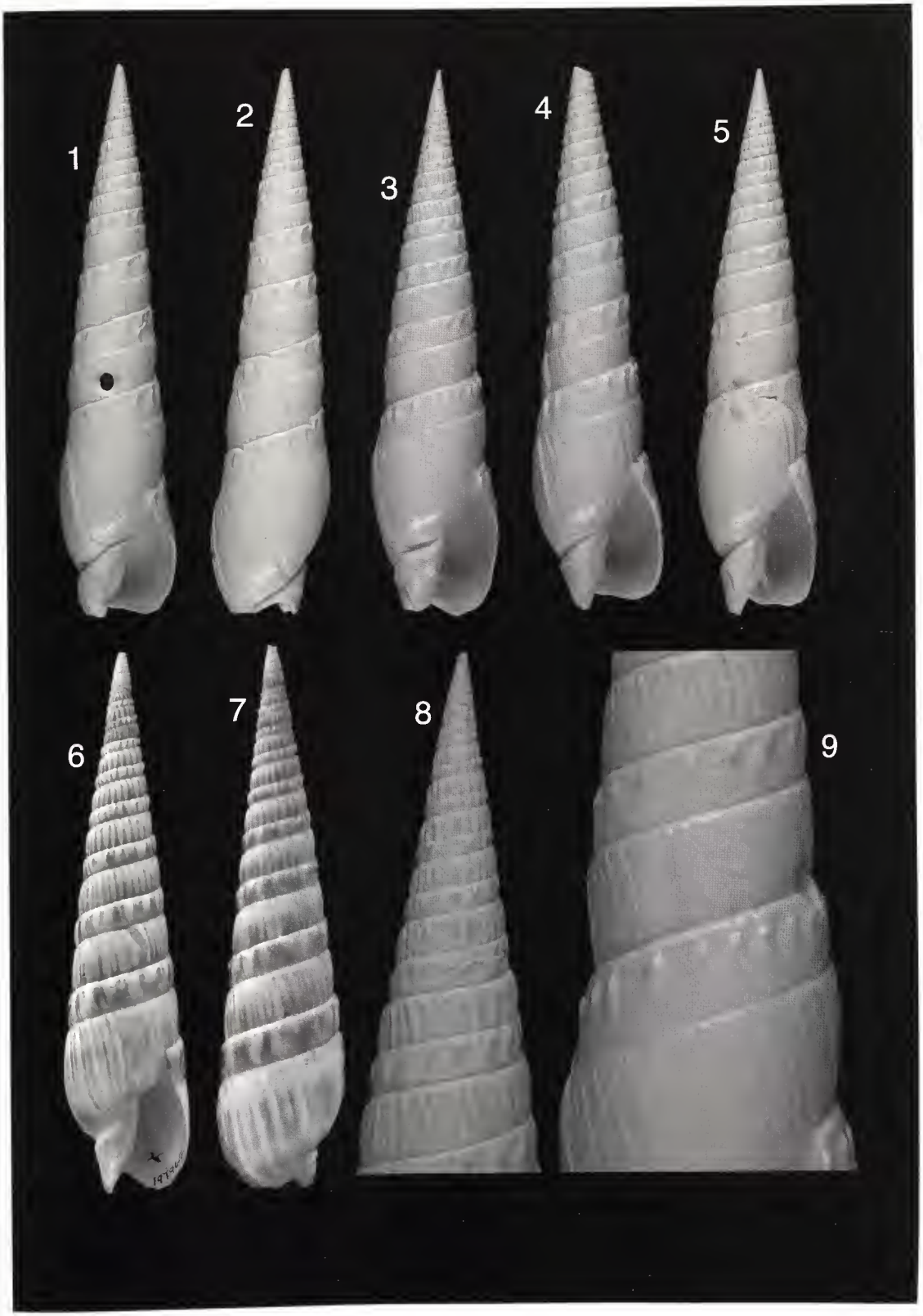
Le récent inventaire des mollusques de Polynésie Française (Tröndlé & Boutet, 2009) fait état de la présence de 66 espèces de Terebridae dont 59 clairement identifiées. Parmi les grandes espèces *Terebra dimidiata* (Linné, 1758), espèces à large répartition indo-pacifique, est la seule a possèder un aspect général relativement proche de *Terebra niauensis*. Cependant la sculpture de *Terebra dimidiata* est constante (Bratcher & Cernohorsky, 1987) et son test entièrement lisse, à l'exception des tout premiers tours, à la différence de *Terebra niauensis*. Une autre espèce *Terebra caledonica* Sowerby, 1909, récemment redécouverte (Conde & Terryn, 2003), endémique de l'Île des Pins, extrêmement variable dans sa sculpture, possède certaines formes également proches de *Terebra niauensis* mais en diffère par sa taille plus petite et son aspect général plus trapu.

Plusieurs études ont été réalisées sur les faunes malacologiques du pléistocène des îles avoisinantes de la Polynésie Françaises où peu ou pas de Terebridae ont été signalés: Tongatabu [Ostergaard , 1935 (*T. cerithina*, *T. subulata*)], Hawaii [Ostergaard, 1939 (*T. gouldi*)], Henderson [Spencer & Paulay, 1989 (aucun Terebridae)]. En revanche 9 espèces sont citées par Ladd (1982, p. 81-85, pl. 30) du pléistocène des Nouvelles Hebrides (Vanuatu). Parmi elles, deux espèces sont proches de *T. niauensis*: *T. dimidiata* [déterminée de façon erronée comme *T.* cf. *felina* (pl.30, fig. 10-12)] et *Terebra* (*Oxymeris*) *interlineata* Deshayes (pl. 30, fig. 9). La détermination de cette dernière est faite par Ladd sur un seul exemplaire. *T. interlineata*, considérée comme synonyme de la très variable *Terebra crenulata* (Linné, 1758), possède une sculpture axiale de ses premiers tours différente; par ailleurs seules des lignes brunes ornent la bande sous suturale et non des taches. L'exemplaire de Ladd est difficile à séparer des exemplaires juvéniles, de taille identique, de *T. niauensis*.

Etymologie. L'espèce est nommée d'après la localité type.

Figures 1-9

1-5, 8, 9. *Terebra niauensis* n. sp. **1, 2.** Holotype MNHN 23685, 96,5 mm; **3, 8, 9.** Paratype CRIOBE, 89,5 mm; **4.** Paratype MNHN 23686, 78 mm; **5.** Paratype Coll. JT, 61,2 mm.
6, 7. *Terebra gouldi* Deshayes, Lectotype 197962/1 BMNH, 61,6 mm.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New record of *Typhinellus labiatus* (Cristofori & Jan, 1832) (Gastropoda: Muricidae) from São Tomé and Principe and discussion about its classification and geographical distribution

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KEY WORDS. Gulf of Guinea, São Tomé and Principe, biogeography, Muricidae, Typhinae.

ABSTRACT. The natural history of the islands of São Tomé and Principe is briefly discussed and a new record of a large typhine from Sao Tomé and Principe is commented. The examined specimens belongs to *Typhinellus* and are compared with the type species *T. labiatus* (Cristofori & Jan, 1832), occasionally better known as *T. sowerbii* (Sowerby, 1833), a junior synonym. A list of the Muricidae collected in these islands is given in the appendix.

INTRODUCTION

São Tomé and Principe Islands are a group of small islands, relict of an ancient volcanic mountain range situated off the west African coast. They consists of two principal islands, São Tomé and Principe. They lie along a magmatic geological feature known as the Guinea line which is a flaw in the African tectonic plate more or less 1500 kms long that has served as a channel for magmas for million of years. The Guinea line extends across the ocean continent and magmatic extrusions up through it have given rise to major oceanic and continental relief extending from southwest to northeast, including the islands of Annobon, São Tomé, Principe and Bioko and the mainland features of Mount Cameroon, the Cameroon highlands and the Jos plateau of Nigeria (Drewes & Wilkinson, 2004).

The islands of Annobon, São Tomé and Principe are long known for the high level of endemism in their biota and some taxa are shared in the latter two. The three islands are separated from each other and from the West African coast by ocean depth up to 3000 m. Principe islands is geologically the oldest. São Tomé being the largest with 850 square kilometers is situated on the equator line, south of Principe island and with other small islets (Ilheu das Cabras, Ilheu Santana, Sete Pedras, Ilheu das Rolas, Ilheus Gabado/San Miguel and Ilheu Coco near São Tomé; Ilheu Tinhosa grande, Ilheu Tinhosa pequena, Ilheu Bone de Joquei, Pedra Gale and Ilheu dos Mosteiros near Principe). São Tomé, Principe and the small islets form the Republic of São Tomé and Principe.

One of the junior authors (SG) has travelled several times to both Islands, collecting eight times in São Tomé and twice in Principe. Collecting has been in various habitats and with different methods (scuba diving, using tangle nets or washing dead corals and small stones) both by day and night producing a sampling from 5 to 40 m depth.

Previous research has been conducted by a number of earlier collectors as summarized by Fernandes & Rolán (1993) who themselves collected extensively in the islands primarily by snorkelling. Other recent works concerning muricids from the islands include Fernandes & Rolán (1990), Rolán & Fernandes (1991), Houart & Rolán (2001). Thanks to the introduction of scuba facilities in the area it was also possible more recently to explore the rocky coastlines more intimately and other new species of Muricidae have been described : Houart (2005), Rolán & Gori (2007), Houart & Gori (2008).

Among the various muricids collected in both Islands (see appendix), a large typhine has led to a careful and refined examination.

Typhinae species have a small size, rarely exceeding 40 mm in height, and have the particularity to grow hollow tubes (Fig. 1) situated between each pair of varices. These anal tubes are gradually closed and broken during the growth of the shell, only the last tube

remains open and can be long to very long when intact (Fig. 17).

The situation of these tubes compared to the axial varices is used among other things as a tool for their generic classification. These tubes may be either situated half way between the varices or nearest to preceeding or succeeding varix, or even originate from the varix itself. The shell of Typhinae also has a sealed siphonal canal, four or very rarely five varices per whorl and, in some genera, a partition (Fig. 1), which is a lamellar outgrowth, or erect plate, joining the last varix of the whorl with the previous one. The edge of the aperture is erect and forms an entire peristome.

The examined protoconchs of all the Recent species are paucispiral, consisting of 1.5 to 2 whorls.

Abbreviations

JLD: Coll. Jean-Louis Delemarre – P: Principe – PR: Coll. Peter Ryall – RH: Coll. Roland Houart – SG: Coll. Sandro Gori – ST: São Tomé – lv: live-taken specimen – dd: empty shell.

Descriptions of spiral sculpture use the terminology introduced by Merle (1999, 2001):

P - Primary cord; P1 - Shoulder cord; P2-P6 - Primary cords of the convex part of the teleoconch whorl.

SYSTEMATICS

Family **TYPHINAE** Cossmann, 1903

Genus ***Typhinellus*** Jousseaume, 1880

Type species by original designation: *Typhis sowerbii* Broderip, 1833 = *Murex labiatus* Cristofori & Jan, 1832, Mediterranean, East Atlantic

The shells belonging to *Typhinellus* are characterized in having a partition. There are four flange-like, frilled varices, constricted above the aperture and flaring at its abapical end; the varical flange of the last teleoconch whorl extends to almost the tip of the siphonal canal. The anal tube does not originate from the varix but is situated near the preceeding varix, and adpressed to the preceeding partition.

Typhinellus labiatus (Cristofori & Jan, 1832)
Figs 1-29

Murex fistulatus Risso, 1826 (not *Muricites fistulatus* Schlotheim, 1820).
Murex labiatus Cristofori & Jan, 1832
Typhis sowerbii Broderip, 1833
Murex tetrapterus Bronn, 1838
Murex syphonellus Bonelli in Bellardi & Michelloti, 1841
Typhis (Typhinellus) tetrapterus var. *protetrapterus* Sacco, 1890
Typhis sowerbyi var. *fulva* Pallary, 1906
Typhis sowerbyi var. *minor* Pallary, 1906
Typhis (Cephonochelus) recens Nordsieck, 1972
Typhis sowerbyi elongatus Settepassi, 1977

Material examined from São Tomé and Principe

São Tome. In fine sand and silt, 6 m, 1 lv (PR) (Figs 11-14); Ubabudu Reef, NE São Tomé, 00°15'804" N, 06°45'569" E, 20 m, 1 dd (PR); Lagoa Azul, NW São Tomé, 1 lv (SG) (Figs 6-7); Lagoa Azul, NW São Tomé, 10-14 m, 1 lv (SG); Lagoa Azul, NW São Tomé, 15 m, 1 lv (SG)

Principe. Bahia das Agulhas, 01°36'06" N, 07°20'55" E, 15 m, 1 lv (SG) (Figs 9-10); Praia Evora, San Antonio, 01°38'24" N, 07°26'34" E, 7 m, on muddy sand, 1 dd (SG).

DISCUSSION

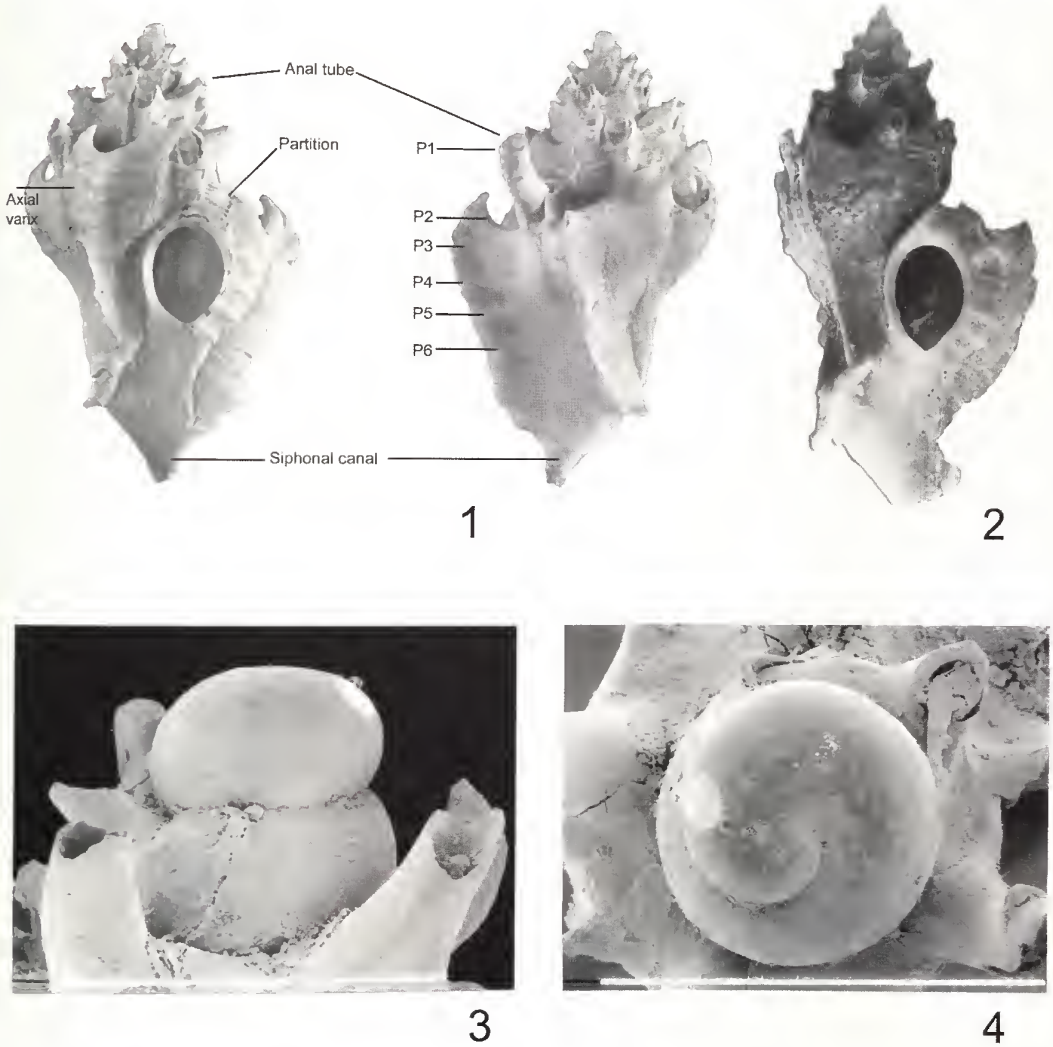
Keen (1944: 56) regarded *Murex labiatus* as a possible *species dubium* (sic) because Bellardi (1873) had earlier placed *Murex labiatus* in the synonymy of *M. fistulosus* Brocchi, 1814. Her decision was tentative because she had not seen a copy of their work and later Gertman (1969: 156) considered it was best to follow Keen's suggestion and consider *Murex labiatus* as a *nomen dubium*. However, the lectotype of *Murex labiatus* was figured afterwards by Pinna (1971: pl. 76, fig. 12) and by Pinna & Spezia (1978: pl. 35, fig. 1). *Typhis labiatus* was described from the Pliocene of Castell'Arquato and is undoubtedly conspecific with the Recent *Typhinellus sowerbii*. A Pliocene specimen from Castell'Arquato is here illustrated for comparison (Figs 23-24). *Typhinellus labiatus* was also commented and illustrated by Houart (2001).

There are no stable differences observed between the Mediterranean shells and the specimens collected in São Tomé and Principe. The specimens from West Africa are larger, occasionally almost twice as big as the Mediterranean shell but also with at least one additional teleoconch whorl. The spire looks also to be lower but we could not yet examine a specimen from Sao Tomé or Principe with an intact apex, all of them having the first whorls eroded, so that :

1. The spire could be as high than in *T. labiatus* from the Mediterranean if we add the protoconch and teleoconch whorls 1 and 2.

2. We don't know exactly the number of teleoconch whorls in the specimens from São Tomé and Principe, although the larger ones probably has 6 or 6.5 teleoconch whorls *vs* 4.5 or 5.5 in the examined Mediterranean specimens; as a reminder also, one of the syntypes of *Typhis sowerbii* is a large specimen of 24.5 mm (Fig. 2).

The axial sculpture consists of 4 rounded varices with a sharp lamellae, ending with a short, strongly recurved spine at shoulder. The anal tube is strongly backward recurved, forming an angle of approximately 65-85° with the axis of the shell. The last anal tube (when intact) is long and hollow, the others are gradually shorter and closed. They are strongly adpressed to the preceding partition. The spiral sculpture consists of low cords, more apparent on the



Figures 1-4 - *Typhinellus labiatus* (Cristofori & Jan, 1832)

1. Nomenclature. Livorno, Italy, 13.6 mm, (RH).
2. Syntype of *Typhis sowerbii* Broderip, 1833, Mediterranean, 24.5 mm, BMNH 197461.
3-4. Protoconch. SEM J. Cillis, IRSNB, scale bars 1000 µm.

varices, ending as more or less recurved, short spines on varices. There are 6 primary cords (Fig. 1), P1-P6, occasionally shallow or almost obsolete in some specimens, sometimes with one to three secondary cords between P2 and P3 and/or P3 and P4, or P5 and P6.

The protoconch has not yet been examined. The protoconch of Mediterranean specimens consists of 1.5-1.75 whorls (Figs 3-4).

Other specimens of *T. labiatus* were reported from the western Atlantic. Gertman (1969: pl. 1, fig 5a-5c) illustrated a typical specimen of 17 mm from the Leeward Islands, near Nevis and reported the species also from Portobelo, Panama, from off Texas and from Egmont Key, Florida. Other specimens from the western Atlantic are occasionally larger and broader (Figs 25-29) but like Gertman (1969: 156), we also feel that these differences are within the range of variation of *T. labiatus*.

A specimen collected in Principe by SG was eating a small bivalve.

Fernandes & Rolán (1993: 38) reported they had collected in São Tomé a species they recorded as *Typhis cf. clarki* Keen & Campbell, 1964. We suspect these authors were referring to the species which is the basis of this paper as one of the current authors (PR)

has material from the late Francisco Fernandes herein illustrated (fig. 11-14).

Houart (1997: 84-85, figs. 234, 235) illustrates a specimen of *Typhina expansa* (Sowerby, 1873) as *Typhis (Talityphis) expansus* from the geographically close area of Ile Banié, Gabon. However this species lives in a different substrata of very fine and thick sediment washed down the nearby rivers. The animal lives submerged in detritus and only the tip of the canal exits the surface (PR personal observation). In the islands, however, *T. labiatus* live on silty or muddy sand (SG). *Typhina* and *T. expansa* can be distinguished from *Typhinellus* by having a varical flange broadly expanded adapically, extending to midway of the siphonal canal; by having a broader last teleoconch whorl relative to the shell height, and by having the anal tube near the preceeding varix, but not adpressed as in *Typhinellus*.

The examination of the syntypes of *T. belcheri* proved *Typhina* to be congeneric with *Talityphis* (Houart, 2002).

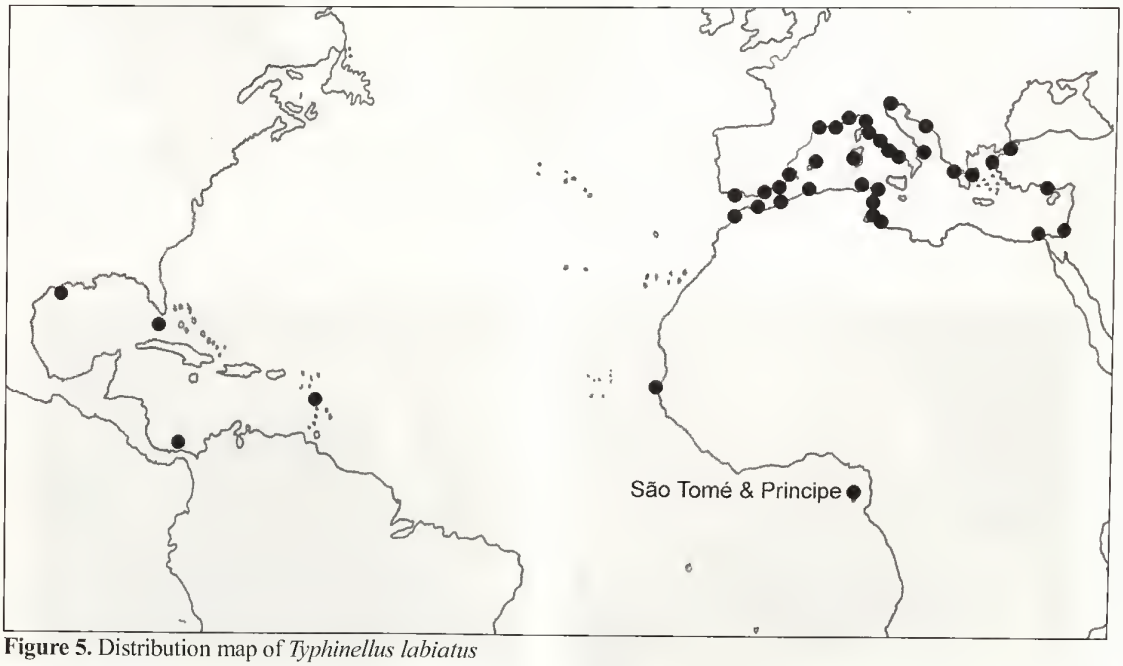


Figure 5. Distribution map of *Typhinellus labiatus*

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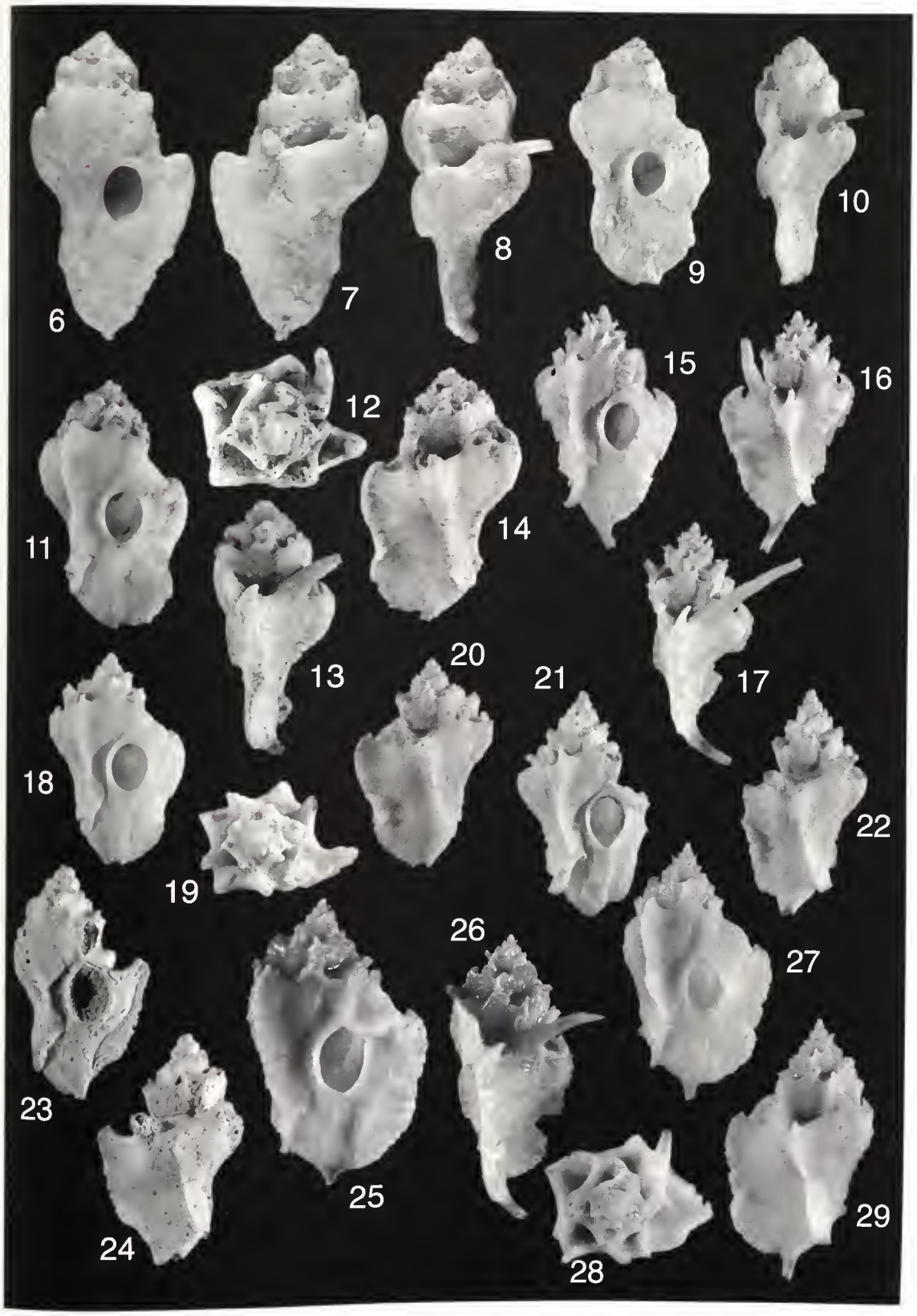
Figures 6-29 - *Typhinellus labiatus* (Cristofori & Jan, 1832)

6-8. São Tomé, Lagoa Azul, 31.2 mm, (SG); **9-10.** Bahia das Agulhas, Principe, 15 m, 24.1 mm, (SG); **11-14.** Off Sao Tomé, 6 m, in fine sand/silt, 21.9 mm, (PR); **15-17.** Kerkennah, Tunisia, 20.1 mm, (RH); **18-20.** Kerkennah, Tunisia, 15.2 mm, (RH); **21-22.** Mallorca, 16.6 mm, (RH); **23-24.** Castell'Arquato, Piacenza, Italie, Pliocene, 16.8 mm, (RH); **25-26.** Portobelo, East Panama, 60 m, 28.7 mm, (RH); **27-29.** Portobelo, East Panama, 60 m, 26.5 mm, (RH).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Appendix

List of Muricidae (excluding Coralliophilinae) collected in São Tome (ST) and Principe (P)
(*) = endemic

Bolinus cornutus (Linnaeus, 1758) (ST)	Fernandes & Rolán, 1993
Hexaplex rosarium (Röding, 1798) (ST & P)	JLD, PR, SG, Fernandes & Rolán, 1993
Favartia (Favartia) emersoni (Radwin & D'Attilio, 1976 (ST)	SG, **new record**
Favartia (Murexiella) bojadorensis (Locard, 1897) (ST)	SG, **new record**
Homalocantha melanamathos (Gmelin, 1791) (ST & P)	SG, **new record**
Muricopsis delemarrei Houart, 2005 (ST & P) (*)	JLD, PR, RH, SG
Muricopsis hernandezi Rolán & Gori, 2007 (ST) (*)	PR, RH, SG
Muricopsis matildeae Rolán & Fernandes, 1991 (ST) (*)	JLD, PR, RH, SG, Fernandes & Rolán, 1993
Muricopsis principensis Rolán & Fernandes, 1991 (P) (*)	PR
Muricopsis rutilus mariangelae Rolán & Fernandes, 1991 (ST & P) (*)	JLD, PR, RH, SG, Fernandes & Rolán, 1993
Muricopsis testorii Houart & Gori, 2008 (ST) (*)	PR, RH, SG
Pradoxa confirmata Fernandes & Rolán, 1989 (ST & P) (*)	JLD, PR, RH, SG, Fernandes & Rolán, 1993
Pradoxa thomensis Fernandes & Rolán, 1989 (ST & P) (*)	PR, RH, SG, Fernandes & Rolán, 1993
Inermicosta inermicosta (Vokes, 1871) (ST & P)	JLD, Fernandes & Rolán, 1993
Morula nodulosa (C.B. Adams, 1845) (ST & P)	JLD, PR, SG, Fernandes & Rolán, 1993
Trachypolia turricula (Maltzan, 1884) (ST & P)	PR (maybe reported in Fernandes & Rolán, 1993 as *Ocinebrina suga*)
Stramonita haemastoma (Linnaeus, 1767) (ST & P)	JLD, Fernandes & Rolán, 1993
Thais nodosa (Linnaeus, 1767) (ST & P)	JLD, Fernandes & Rolán, 1993
Typhinellus labiatus (Cristofori & Jan, 1832) (ST & P)	PR, SG (maybe reported in Fernandes & Rolán, 1993 as *Typhis* cf *clarcki)*

A few species mentioned by Fernandes & Rolán (1993) are questionable or/and actually junior synonyms. They were mostly quoted from older records:

Murex turbinatus Lamarck, 1822. Is a synonym of *Hexaplex duplex* (Röding, 1798)

Murex hoplites Fischer, 1876. Is a synonym of *Hexaplex duplex* (Röding, 1798)

Murex tumulosus Sowerby, 1841. Is a synonym of *Bolinus cornutus* (Linnaeus, 1758) (see above)

Muricopsis blainvillei Payraudeau, 1826. Is a synonym of *Muricopsis cristatus* (Brocchi, 1814)

As mentioned by Fernandes & Rolán (1993: 45 [C9]): "we have not found this species and the record is probably due to the confusion with some of the recently described species and mentioned in the list", this makes reference to *Muricopsis mariangelae* and *M. matildae* (E. Rolán in litt.).

Ocinebrina suga (Fischer-Piette, 1942). See above under *Trachypollia turricula*

Typhis cf. *clarki* Keen & Campbell, 1964. See above under *Typhinellus labiatus*

Thais ascensionis (Quoy & Gaimard, 1832). Is a synonym of *Thais nodosa* (see above)

Thais neritoidea (Linné, 1767). Is a synonym of *Thais nodosa* (see above)

Two new species of *Epitonium* (Gastropoda: Epitoniidae) from the western Atlantic

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KEYWORDS. Gulf of Mexico, Florida, Puerto Rico, taxonomy, Epitoniidae, *Epitonium* n. spp.

ABSTRACT. Two new *Epitonium* species from eastern Florida, the Gulf of Mexico and Puerto Rico are described and compared with similar congeners. Special attention is given to *E. championi* Clench & Turner, 1952, the most similar to the two proposed new taxa.

INTRODUCTION

In June, 2005, faculty members and graduate student in the Biology Department at the University of Louisiana, Lafayette went on a research expedition to Bahía de Campeche, southern Gulf of Mexico, on board the R/V Pelican, a research vessel operated by the Louisiana Universities Marine Consortium (LUMCON). Results of this expedition have been reported elsewhere (García, 2006, 2007, 2008a, 2008b, 2008c). This area of the Gulf, located in the southwest quadrant, has been poorly sampled. The single campaign in 2005 increased the known diversity of the area from 575 to 674, that is by 17% (Rosenberg et al., 2009: 584).

Among the interesting material dredged in 120 hauls in Bahía de Campeche, there was an epitoniid species, collected at only two consecutive stations. Although there have been 56 species of Epitoniidae recorded from the Gulf of Mexico (Rosenberg et al, 2009: 583), the Campeche specimens defied identification. The species looked similar to *Epitonium championi* Clench & Turner, 1952, a taxon that had been erroneously reported from the Gulf of Mexico (García & Lee, 2002:11; Rosenberg et al., 2010: 641); however, upon close inspection of the holotype of *E. championi* and other type material, important differences came to light. Moreover, after studying other epitoniids from the Gulf and elsewhere, mostly from the Harry G. Lee collection, a second undescribed species was revealed that had been hitherto identified as *E. championi* and *E. turritellula*. This was a very surprising find, as the species inhabits a large area, at least from Texas and Louisiana to Sanibel Island, northeast Florida and Puerto Rico.

This study proposes two new *Epitonium* taxa and scrutinizes them against their most similar congener, *E. championi*, as well as other less- likely congeneric taxa.

Abbreviations

BMSM: Bailey- Matthews Shell Museum, Sanibel, Florida, USA.
EFG: author's collection.
HGL: Harry G. Lee collection, Jacksonville, Florida, USA.
HMNS: Houston Museum of Natural Science, Houston, Texas, USA.
LACM: Los Angeles County Natural History Museum, Los Angeles, California, USA.
MCZ: Museum of Comparative Zoology, Cambridge, Massachusetts, USA.
SBMNH: Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
UNAM: Universidad Nacional Autónoma de México, Ciudad México,México.
USNM: United States National Museum, Washington, D.C., USA.
spec: specimen(s).

SYSTEMATICS

Family **EPITONIIDAE** S. S. Berry, 1910
Genus ***Epitonium*** Röding, 1798
Type species: *Turbo scalaris* Linnaeus, 1758 by subsequent designation by Suter (1913).

***Epitonium championi* Clench & Turner, 1952**
Figs 1-12, Table I

Material examined. Holotype MCZ 182900 length 11.5 mm, width 4.6 mm, Massachusetts, Cape Cod, Hyannis, Lewis Bay (Figs 1-5); 3 paratypes, MCZ 162585 Massachusetts, Martha's Vineyard, Gay Head (see Figs 6 and 7) ; 6 spec.; Emerald I., North Carolina, 34°40'1"N 77°0'49"W (HMNS 47485); Stone Harbor, New Jersey, 39°02'8"N 74°46'03"W (HMNS 47484) (Fig. 9), 1 spec.; Florida, Duval County, off Big Talbot I., 10-20 m (see Figs 10 to 12) (HGL); 2 spec., Florida, Duval County, S.Jacksonville Beach (see Fig. 8) (HGL); 1 spec., Florida, Duval County, Fort George(HGL).

Distribution. South coast of Cape Cod, Massachusetts to Duval County, NE Florida.

Original description. " Shell reaching about 14 m (1/2 inch in length, attenuate, imperforate, rather solid

and strongly sculptured. Whorls 10 to 11, convex and attached. Color a flat white to a light cream. Aperture subcircular, with both the palatal and parietal margins thickened. The palatal or outer lip being greatly thickened in older specimens. Columella short and arched. Spire extended and produced at an angle of 20°. Suture moderately impressed. Axial sculpture consisting of 8 or 9 flattened cord-like, slightly impressed costae which are rather variable as to width. Spiral sculpture consisting of 19 to 20 flattened ridges, those nearest the umbilical area being a little narrower. Basal ridge absent. Operculum thin, paucispiral and brown in color. Nuclear whorls 2 1/2 to 3,smooth and opaque" (Clench and Turner, 1952:318).

Discussion. In their original description Clench and Turner (1952:318) described *E. championi* as having flattened, cord-like axial costae and flattened spiral ridges. Later on, in their "Remarks," they elaborate on this distinctive sculpture, stating that it "appears much like a basket weave in which the upright and outer struts (the axial costae) are woven tightly, causing the horizontal weave (the spiral ridges)to bulge outwardly between the struts" (p. 319). This peculiar character of the species is clearly seen on Fig. 4, a close-up of the holotype, and Fig. 12, a specimen dredged off Duval County, Florida.

The authors subsequently state that *E. championi* "is perhaps a divergent element of *E. candeanum*, in which both axial and spiral sculpture have had an excess of development" (p. 319); however, *E. candeanum* has blade-like axial costae and a microsculpture of axial and spiral threads. Clench & Turner did not observe the presence of a microsculpture in the type material of *E. championi*, nor did I on examining them. This character was also lacking from all the specimens examined, including those from northeast Florida (see Figs 4 & 12). The juxtaposition of *E. candeanum* and *E. championi,* i.e., blade-like vs. cord-like axial costae, has lead to the misidentification of the species described herein as *E. leali*, which does show the cord-like (although not very flattened) costae of *E. championi* but also a microsculpture between the axial elements lacking in the latter. Other differences will be shown in the discussion of the former.

The maximum reported size of *E. championi* is 13.7 mm (Rosenberg, 2009); however, I have examined a specimen from the Houston Museum of Natural Science (No. 47484) that measures 17mm (Fig. 9).

Although Dr. Lee's collection shows that E. *championi* is well-represented in NE Florida, the specimens of *Epitonium "championi"* from the Gulf of Mexico that I have examined, as well as the specimen shown in the *Encyclopedia of Texas Seashells* (Tunnell et al, 2010:190) are misidentifications.

Epitonium leali n. sp.

Figs 13- 26, Table II

Epitonium championi Clench & Turner, 1952- García & Lee, 2002:11.
Epitonium championi Clench & Turner, 1952- Lee, 2009: 95, fig. 454.
Epitonium championi Clench & Turner, 1952- Rosenberg et al., 2010:641.
Epitonium turritellula (Mörch, 1875)- Tunnell et al., 2010: 193.

Type material. Florida, Gulf County, St. Joe Bay, Palm Point, 29°48'29"'N 85°17'52"W. Holotype USNM 1150471 length 9.7 mm, width 3.6 mm (Figs 13-17) ;1 paratype SBMNH 149690 (Fig. 18); 1 paratype BMSM 17956 1 paratype EFG 29966; 7 paratypes HGL all from the type locality.

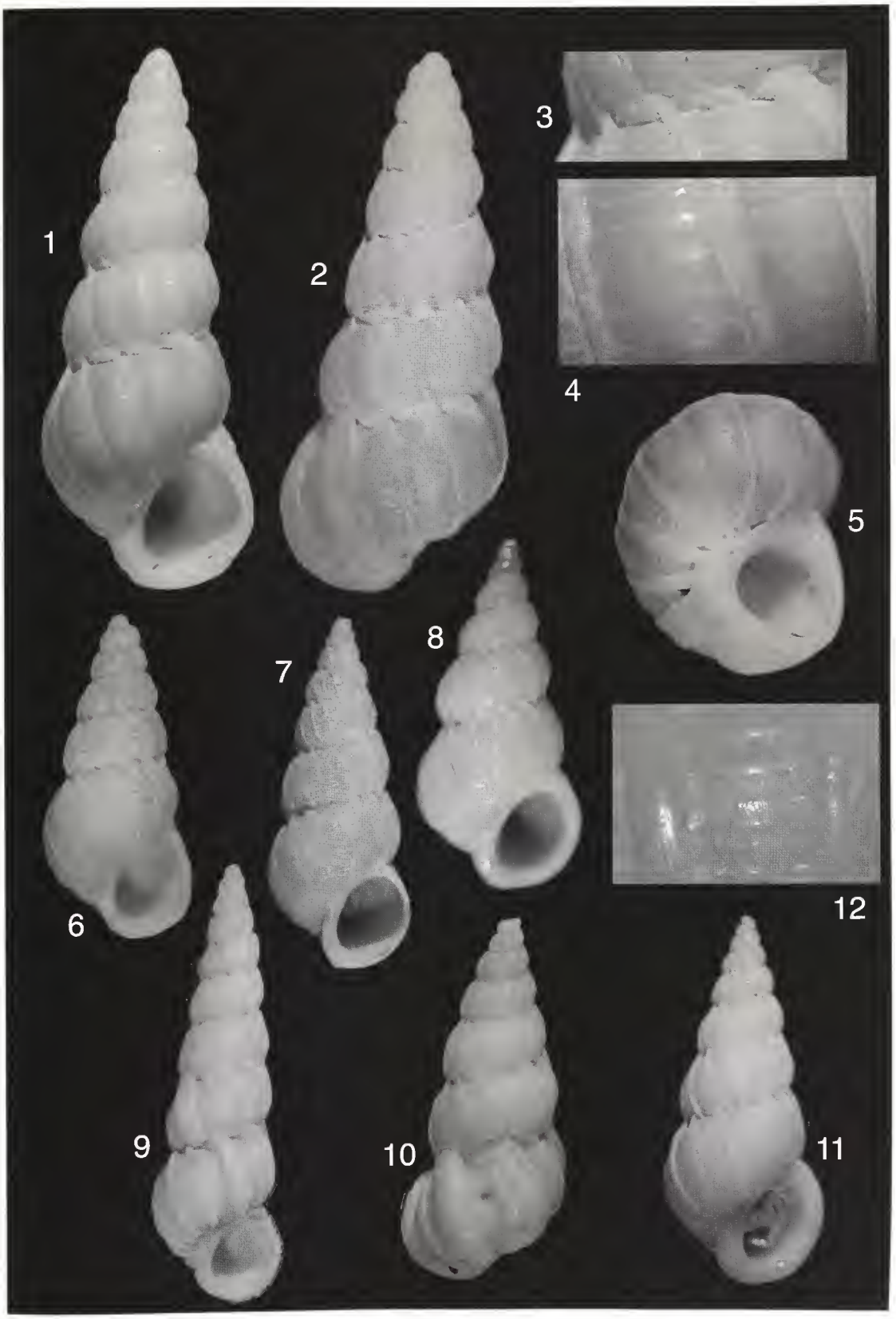
Type locality. Florida, Gulf County, St. Joe Bay, Palm Point, 29°48'29"'N 85°17'52"W.

Other material examined. **Puerto Rico**: San Juan, Isla Verde, 18° 25' 39" N, 66° 0' 36" W (Figs 24-26)(1 spec., HGL). **Florida:** Duval County, off Big Talbot I., 10-20 m (7 spec. HGL)(see Figs 19 and 20) ; Lee County, Sanibel Island ,26°27'N 82°01' W (3 spec.; BMSM 5687, BMSM 25698, BMSM 25708)(see Fig. 21); west end of St, Vincent I., 29.66° N 85.13° W (HMNS 47413). **Louisiana:** Terrebonne Parish, Isles Derniers, 29°3'41.44"N, 90°57'1.51"W (1 spec., HGL; 2 spec. EFG 10350)(see Fig. 23). **Texas:** Heald Bank 29°12.5'N, 92°10.8'W, 10-13 m (1 spec., EFG 12861); Nueces Co, Port Aransas, 27° 50' 1" N, 97° 3' 39" W (2 spec., HGL)(see Fig. 22); San Luis Pass, Galveston, 29°5'2"N 95°7'12"W (HMNS 39743);

Distribution. Puerto Rico, east Florida, west Florida, Louisiana, Texas.

Figures 1-12. *Epitonium) championi* Clench & Turner

1-5. Massachusetts, Cape Cod, Hayannis, Lewis Bay. Holotype MSZ 182900 length 11.5 mm,width 4.6 mm. **6.** Massachusetts, Martha'sVineyard, off Gay head. Paratype, 5.9 mm, **7.** Massachusetts, Martha'sVineyard, off Gay head. Paratype, 9.2 mm **8.** Florida, Duval County, S.Jacksonville Beach, 4.6 mm (HGL). **9.** New Jersey, Stone Harbor, 39°02'8"N 74°46'03"W, 17 mm (HMNS 47484), **10.** Florida, Duval Co., off Big Talbot Island, 10-20 m, 8.4 mm (HGL). **11-12.** Florida, Duval Co., off Big Talbot Island, 10-20 m, 7.7mm (HGL).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Description. Holotype (Figs 13-17) 11.5 mm in length, attenuate (width/ length ratio 0.37). Protoconch damaged, remaining whorl smooth, white. Teleoconch of 8 moderately convex, joined whorls. Suture relatively deep. Axial ornamentation on early whorls of 16 or 17 narrow, well- defined, rounded costae, some becoming varicoid starting on fourth whorl; at least one varix per whorl after fourth; costae diminishing in number on later whorls, 10 on last whorl; posterior terminal embedding into suture, joining earlier whorl (Fig. 15); axial interspaces approximately 3 to 4 times as wide as costae, except where varical formations occur; 4 strong varices on last whorl. Spiral sculpture of 14 or 15 cords between sutures; cords uneven in strength, narrower than interspaces (Fig. 16); interspaces ornamented with numerous microscopic axial threads, which wrinkle top of spiral cords as they cross over (Fig. 16); base of last whorl convex, developing a shallow chink at umbilical area (Fig. 17). Aperture elongate-ovate, complete, with strong, wide labral varix, narrower on parietal side. Operculum unknown. Shell pale pinkish-tan with white axial costae.

Discussion. There is very little variation in all the material studied, other than number and position of varices and slight variation in number of axial costae. Compare holotype Figs 13, 15 and 16 with Figs 24, 25 and 26, the specimen from Puerto Rico; also, see Table II. Some specimens from deeper water have a tendency to develop a more capacious last whorl, which also causes them to have a stronger umbilical depression (Figs 19 and 20). Fresh specimens, such as those from the type locality and the specimen from Puerto Rico (Figs 24 to 26), have a pale pinkish- tan shell with white axial costae; all other specimens are white.

This new species has been confused with *Epitonium championi,* from which it differs by having more rounded axial costae which embed into a deeper suture (Compare Fig. 3 with Figs 15 and 26), in having narrower spiral cords that do not "bulge", in having a secondary microsculpture in the axial interspaces (Compare Figs 4 and 12 with Figs 16 and 25), and in generally having a narrower shell (width/ length ratios 0.36 vs o.40). Although some specimens of *E. leali* do approach the same ratio as *E. championi*, this is due to the strong development of the last whorl.

Epitonium leali may also be confused with *Epitonium pigrum* n. sp. The differences between the two taxa will be treated in the discussion of the latter.

Epitonium tiburonense Clench & Turner, 1952 is superficially similar to *E. leali*, but the former is smaller; the holotype having 9 whorls at only 6.8 mm in length. Moreover, *E. tiburonense* has evenly distributed non- varicoid axial costae which "form a thickened pad" (Clench & Turner, 1952: 305) in the umbilical area, and lacks the secondary microsculpture of *E. leali.*

Although *Epitonium turritellula* Mørch, 1874 has been confused with the new species (Tunnell et al., 2010: 93), the former only grows to 6.5 mm (Rosenberg, 2009), producing 10 whorls at only 6.4 mm in length (Clench & Turner, 1952: 298). Also, *E. turritellula* has blade- like, more numerous costae (about 20 on last whorl) that tend to "peak" at the suture, giving the appearance of narrowly coronated whorls.

Although all of the specimens of *Epitonium leali* in this study were collected empty, it seems that the species inhabits very shallow water in the Gulf of Mexico, as most specimens have been collected at beaches from southwestern Florida to Texas.

Etymology. Named for Dr. José H. Leal, Director of the Bailey- Matthews Shell Museum, Sanibel, Florida and Editor of the prestigious malacological journal *The Nautilus*. This taxon honors him for his accomplishments in the field and for his willingness to help both personally and in his capacity as the Director of the Bailey-Matthews Shell Museum.

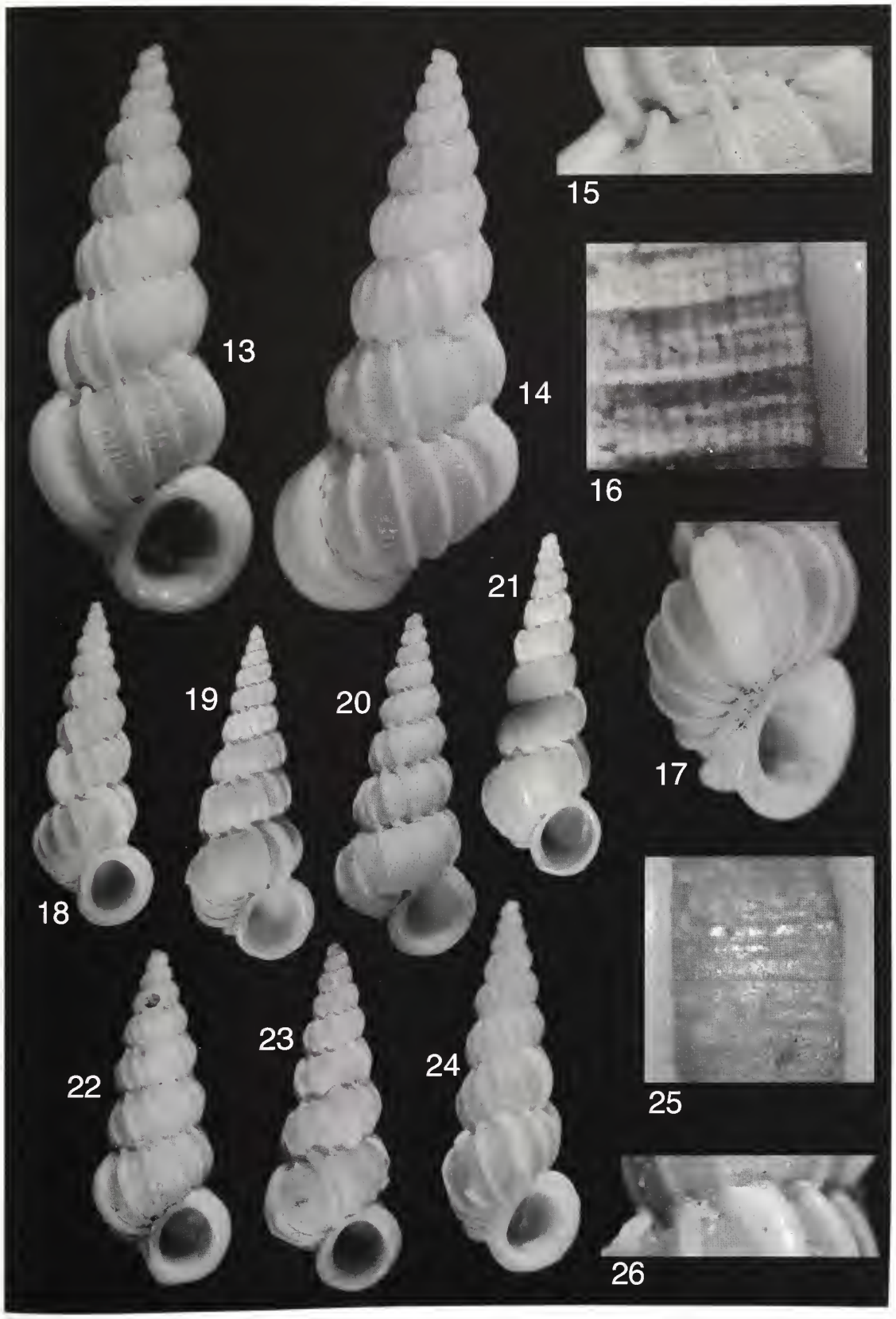
Epitonium pigrum n. sp.

Figs 27- 40, Table III

Type material. Mexico: Bahía de Campeche, 20º51.49'N, 92º21.44'W, in 63-65 m. Holotype USNM1150470 length 11.5 mm, width 4.3 mm; 1 paratype MCZ 373765 (Fig. 32); 1 paratype UNAM; 1 paratype EFG 26207 (Figs 33-34) 1 paratype BMSM 17957 (Fig. 35); 1 paratype SBMNH 149689 (Fig 36); 1 paratype HGL (Fig. 37). Bahía de Campeche, 20º52.40'N, 92º24.83'W, in 77-81 m; 1 paratype LACM 3189 (Fig. 38), 1 paratypes EFG 26273 (Figs 39-40).

Figures 13-26. *Epitonium leali* n. sp.

13-17. Florida, Gulf County, St. Joe Bay, Palm Point, 29°48'29""N 85°17'52"W. Holotype USNM 1150471 length 9.7 mm, width 3.6 mm. **18.** Florida, Gulf County, St. Joe Bay, Palm Point, 29°48'29""N 85°17'52"W. Paratype SBMNH 149690 11mm. **19.** Florida, Duval County, off Big Talbot I., 10-20 m, 14 mm (HGL). **20.** Florida, Duval County, off Big Talbot I., 10-20 m, 13.5 mm (HGL). **21.** Florida, Lee County, Sanibel Island, 26°27'N 82°01' W, 18.5 mm (BMSM 25708). **22.** Texas, Nueces Co, Port Aransas, 27°50'1" N, 97°3'9" W, 8.5 mm (HGL) **23.** Louisiana, Terrebonne Parish, Isles Derniers, 29°3'41.44"N, 90°57'1.51"W, 11.5 mm (EFG 10350). **24- 26.** Puerto Rico, San Juan, Isla Verde, 18°25'39" N, 66° 0' 36" W, 9 mm (HGL).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Type locality. Bahía de Campeche, 20°51.49'N, 92°21.44'W, in 63-65 m.

Other material examined. Louisiana: 28°05'N, 90°59'W, in 114 m (HMNS 39750); 28° 37.920'N, 90° 36.550'W, in 22 m (EFG 23531).**Texas:** SSE of Freeport, 28°15'N, 95°0'W (HMNS 39734); Heald Bank, SSE of Galveston, 29°08'N, 94°01'W(HMNS 39735); S. of Galveston, 29°55'N, 94°41'W, in 20 m (HMNS 39736); SE of Freeport, 28°19'N, 94°29'W, in 50 m (HMNS 39737); off Galveston, 28°52'N, 94°42'W, in 22 m (HMNS 39738); off Galveston, 29°16'N, 94°29'W, in 16 m (HMNS 39740); off Galveston, 28°21'N, 94°53'W (HMNS 39744); 30 mi. off Port Isabel, in 22-28 m (HMNS 39745); off Galveston, 28°18'N, 94°28'W, in 50 m (HMNS 39746); off Matagorda peninsula, 28°35'41"N, 95°58'59'W, in 15 m (HMNS 39747); Padre I., in 4 m (HMNS 39748); off Padre I., in 22 m (HMNS 39749)

Distribution. Western Gulf of Mexico: Bahía de Campeche, Mexico; Texas and Louisiana, USA

Description. Holotype (Figs 27-31) 11.5 mm in length, imperforate, attenuate (width/ length ration 0.37). Protoconch conical, smooth, glassy, with a brownish band on shoulder of whorls, of approximately 4 whorls; transition to teleoconch delineated by growth scar and change in opacity. Teleoconch of 9.5 convex whorls; whorls rapidly increasing in width. Suture relatively shallow, crossed by axial ornamentation. Axial sculpture of approximately 22 thin, erect costae on early whorls; costae curving adaperturally, slightly flattening, as they cross over suture, pasting on to the earlier whorl, some forming inconspicuous "peaks' (Fig. 29), decreasing in number, becoming more cord- like on later whorls; 17 costae on last whorl; varices forming randomly starting at the end of fifth whorl; 3 varices on last whorl; microscopic axial wrinkles showing on interspaces between axial costae. Spiral sculpture of primary cords of uneven strength; microscopic spiral wrinkles appearing between them, creating pustulose surface as they cross axial elements (Fig. 30); spiral ornamentation not crossing over axial elements; approximately12 primary cords on early whorls, increasing in number on later whorls. Base of shell solid; umbilical area covered by parietal thickness (Fig. 31). Aperture oval; parietal and labral margins thickened; labral margin becoming patulose anteriorly, parietal margin narrowing at posterior end. Shell milky-white with slight satin luster.

Discussion. The main characters of the paratypes are consistent with those of the holotype; there is some expected variation in the number of axial costae (see Table III), and in the number and placement of varices.

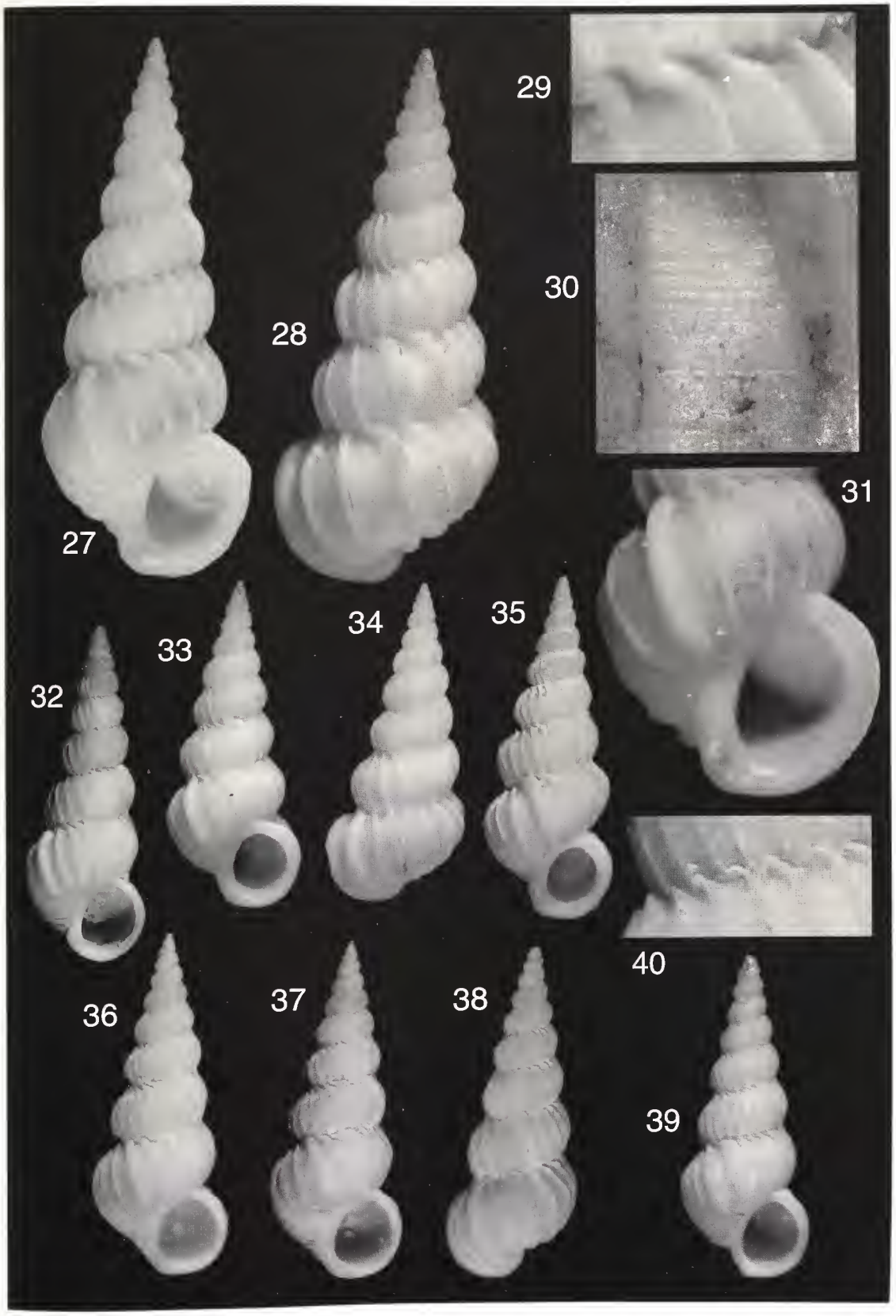
Epitonium pigrum is most similar to *E. leali* n.sp. They both have the same general proportions, a number of varicoid axial costae and similar microsculpture on interspaces. However, *E. pigrum* has more numerous axial costae on early whorls (22 vs. 15) and on the last whorl (15 vs. 10), a shallower suture, and a solid umbilical area without a chink (compare Figs 7 and 35). More importantly, the production of the terminals of the axial costae of the two species as they cross the suture are quite different: *E. pigrum* produces flattened costae which curve adaperturally and adhere to the previous whorl; *E. leali* maintains the rounded costae which embed into the deeper suture and do not turn adaperturally (compare Figs 15 and 26 with Figs 29 and 40). Although both species inhabit the coastal areas of Louisiana and Texas, fresh specimens of *Epitonium leali* can be found on beaches while *E. pigrum* inhabits offshore banks.

Epitonium championi is also similar to *E. pigrum* in general shape, and the production of the terminals of the axial varices is similar, particularly when the specimens are not fresh (compare Fig. 3 with Figs 29 and 40) ; however, *E. championi* has fewer axial costae on early whorls (16 vs. 22) and on the last whorl (10 vs. 15), has more flattened axial costae, wider spiral cords that "bulge" out, and lacks a microsculpture (compare Figs 4 and 12 with Fig. 30).

Etymology. From the Latin *pigrum* (adjective meaning lazy), referring to the relatively large number of prominent varices, presumably periods of rest.

Figures 27-40. *Epitonium pigrum* n. sp.

27-37. Mexico, Bahía de Campeche, 20°51.49'N, 92°21.44'W, 63-65 m. **27-31**. Holotype USNM 1150470 length 11.5 mm, width 4.3 mm. **32.** Paratype MCZ 373765 **33-34.** Paratype BMSM 17957 **35.** Paratype SBMNH 149689 **36.** Paratype LACM 3189 **37** Paratype EFG 26207 **38-40.** Mexico, Bahía de Campeche, 20°52.40'N, 92°24.83'W, 77-81 m **38.** Paratype HGL col. **39-40**.Paratype EFG 26273.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TABLES

Abbreviations: **H:** Holotype; **P**: Paratype; **BT**. Big Talbot I., NE Florida; **Ft.G.**: Fort Geroge, NE Florida; HB: Healds Bank, Texas; **ID**: Isles Derniers, Louisiana; **JX**: Jacksonville Beach, NE Florida; **NJ**: Stone Harbor, New Jersey; **PA**: Port Aransas, Texas; **PR**: Isla Verde, N. Puerto Rico; **SI**: Sanibel Island, W Florida; **SJB**: St. Joe Bay, NW Florida; **SL Pass**: San Luis Pass, Galveston, Texas.
- Juvenile specimens were not included in the tables below.

TABLE I. *Epitonium championi* Clench & Turner, 1952

Specimen	Number of whorls	Length in mm	Width in mm	W/L ratio	Number of early axial costae	Number of axial costae last whorl
H Figs 1-5	7	11.5	4.6	0.40	14	9
P Fig. 7	7	9.2	3.6	0.39	16	11
BT	7.5	10	3.8	0.38	16	10
BT Fig. 11	7	7.7	3.2	0.42	16	10
BT	6	7.5	3.5	0.47	16	9
BT	6	7.1	3.1	0.44	18	9
BT Fig.10	6	8.4	3.5	0.42	17	10
BT	7.5	8.8	3.8	0.43	16	10
Ft.G.	6	5.7	2.2	0.39	18	11
N.J. Fig. 9	8	17	5	0.29	16	9
Average				0.40	16	10

TABLE II. *Epitonium leali* n. sp

Specimen	Number of whorls	Length in mm	Width in mm	W/4 L ratio	Number of early axial costae	Number of axial costae last whorl
H Figs 13-17	8	9.7	3.6	0.37	16	9
P SJB	9	9.9	3.5	0.35	16	8
P SJB Fig. 18	9	11	3.8	0.35	16	10
P SJB	7	10.7	4.2	0.39	14	10
P SJB	8.5	10.7	4.0	0.37	14	10
P SJB	8	9.4	3.6	0.38	16	10
P SJB	6.5	9.8	3.6	0.37	14	9
P SJB	8	8.5	3.2	0.38	16	11
P SJB	9	10	3.8	0.38	12	9
P SJB	8	9.0	3.3	0.37	16	10
PSJB	6.5	7.7	2.8	0.36	14	10
BT Fig. 19	8.5	14.0	5.3	0.38	15	10
BT Fig. 20	8.5	15.8	6.3	0.40	15	10
BT	8.5	13.5	5.0	0.37	16	11
BT	8	12.1	4.9	0.40	16	10
BT	8	8.0	3.0	0.38	18	9
BT	9	10.2	3.6	0.35	13	10
BT	8	7.2	2.7	0.38	17	9
HB	6.5	4.0	1.7	0.42	12	12
PA Fig. 22	7.5	8.5	3.5	0.41	16	10
PA	7.5	7.4	2.7	0.37	18	11
ID Fig. 23	8	11.5	4.3	0.37	13	10
ID	7.5	9.8	3.8	0.39	13	9
ID	7.5	10.7	4.5	0.42	14	9
PR Figs 24-26	8	9	3.2	0.36	15	9
SI	7.5	16.2	5.8	0.36	11	11
SI	8.5	18.6	6.3	0.34	9	10
SI Fig. 21	8.5	18.5	6.3	0.34	12	10
SL Pass	7	9.2	3.6	0.39	16	9
Average				0.36	15	10

TABLE III. *Epitonium pigrum* n. sp.

Specimen	Number of whorls	Length in mm	Width in mm	W/4 L ratio	Number of early axial costae	Number of axial costae last whorl
H Figs 27-31	9.5	11.5	4.3	0.37	22	16
P Fig. 32	10	11	4	0.36	23	16
P	9.5	12.6	4.3	0.34	19	15
P Figs 33-34	8.5	10.9	4.1	0.38	23	15
P Fig. 35	8	11	4	0.36	24	15
P Fig. 36	7.5	9.6	3.7	0.39	22	15
P Fig. 37	8.5	11.6	4.3	0.37	20	13
Average				0.36	22	15

First record of *Pisidium punctiferum* (Guppy, 1867) and *Eupera viridans* (Prime, 1865) (Mollusca: Sphaeriidae) from French Guiana

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KEYWORDS. French Guiana, continental Bivalvia, *Pisidium punctiferum, Eupera viridans*, identification key.

MOTS CLÉS. Guyane, bivalves continentaux, *Pisidium punctiferum, Eupera viridans*, clé d'identification.

ABSTRACT. Two freshwater Bivalvia species identified as *Pisidium punctiferum* (Guppy, 1867) and *Eupera viridans* (Prime, 1865) were collected at several places from French Guiana. Those new records bring the number of freshwater-molluscs species from this French overseas territory to 27 and extend the distribution area of the mentioned species to the Guiana Shield. An identification key to continental Bivalvia from French Guiana is therefore provided.

RESUME. A l'occasion d'une étude hydrobiologique, *Pisidium punctiferum* (Guppy, 1867) et *Eupera viridans* (Prime, 1865) ont été collectés en Guyane. Ces deux bivalves, nouveaux pour l'inventaire, portent à 27 le nombre de mollusques dulcicoles connus de ce territoire ; leur aire de distribution naturelle est étendue en direction du Plateau des Guyanes. Une clé d'identification des bivalves continentaux de Guyane est proposée.

INTRODUCTION

The Guiana Shield is an old Precambrian geological formation of more than 1,600 km long, located in the north-eastern part of South America, including Guyana, Suriname, French Guiana and a part of Brazil (Amazonas, Roraima, Pará and Amapá States, west of the Amazona River). French Guiana (2°- 6° North latitude) stretches over almost 84,000 square kilometres (Figure 1); it is a hot spot of biodiversity because 80% of the territory is covered by a tropical rain forest, considered as one of the 15 last worldwide remaining clumps only partially affected by human activities (Gargominy, 2003 & Hammond, 2005). An abundant and complex hydrographical system feeds this territory where acids and poorly mineralized waters are unfavourable habitats to freshwater molluscs.

The difficulty to reach the upstream areas explains why this group was so poorly studied despite of some consequent but old works (Drouët, 1859 & Tillier, 1980), until the recent publication of a molluscs identification guide (Massemin et al., 2009) in which 24 species of freshwater molluscs are listed. Nevertheless, thanks to hydrobiological investigations carried out in French Guiana under the auspices of the Water Framework Directive and EDF, one species was recently added to that list (Clavier et al, 2010).

The aim of the present article is to report for the first time the presence of two freshwater Bivalvia species in French Guiana (Figure 2). This discovery carries the number of freshwater molluscs species known from French Guiana to 27 (Gastropoda & Bivalvia), belonging to 7 families; it gives the opportunity to the authors to present a general illustrated identification key of the known species of continental Bivalvia inhabiting this territory (Figure 3; appendix 1).

Material and Methods

In order to assess the benthic French Guiana macroinvertebrate fauna [following the definition of Rosenberg and Resh (1993), the term "benthic" means "bottom-living" and the prefix "macro" indicates that

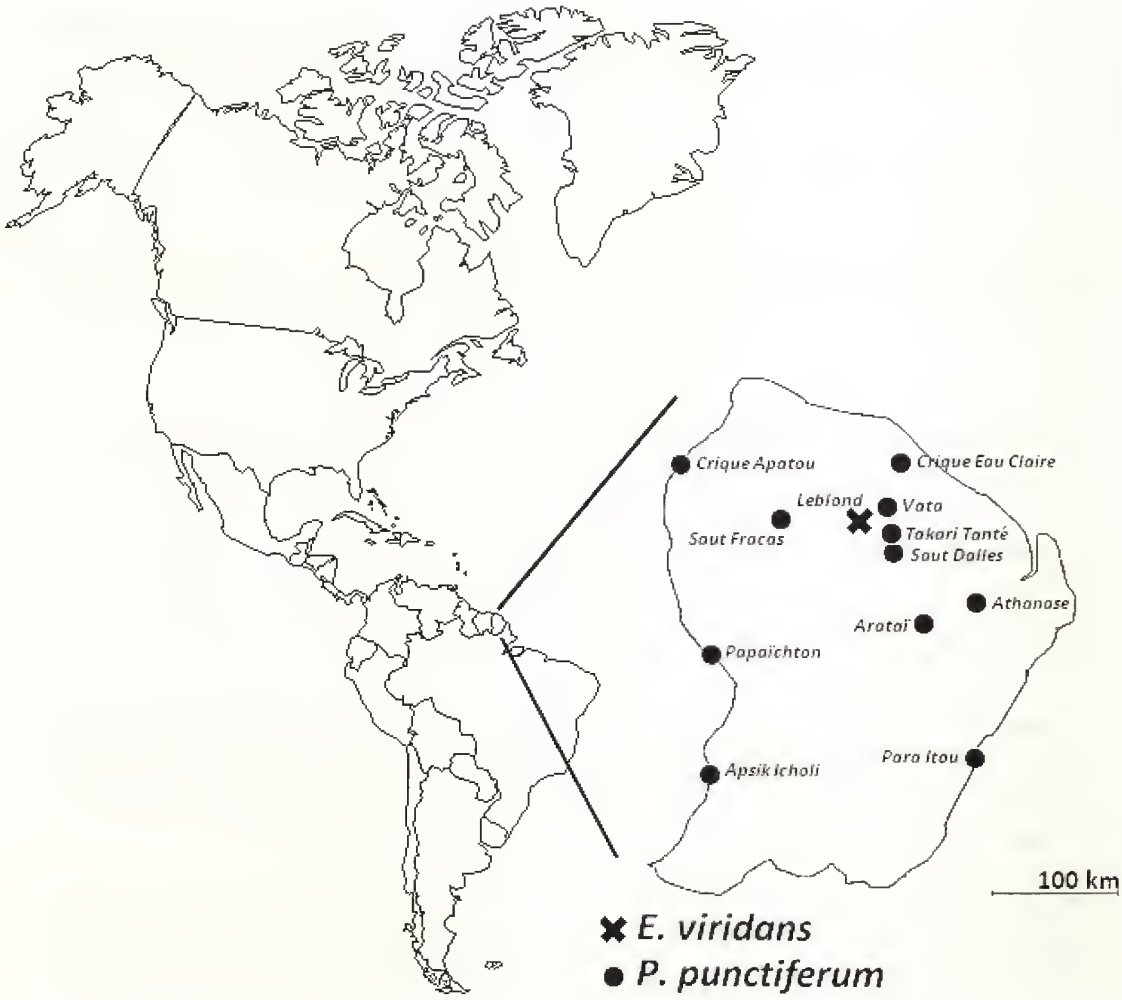

Figure 1. Geographical localization of French Guiana and mentioned localities from French Guiana.

these organisms are retained by mesh size of 200-500 µm], an important hydrobiological study was carried out by HYDRECO laboratory during the dry season 2009 (from September to December), under the auspices of the local representation of the French Ministry in charge of environmental questions (DIREN Guyane).

Samplings were conducted by one of us (SC) on the entire territory in different habitats (large rivers, mid-order streams, small streams named locally "criques" and reservoir lakes) using a D-framed hand net (200 µm mesh size). Samples were collected by sweeping the net along the banks. The first centimetres of the substratum (organic and/or inorganic) were stirred to dislodge attached or buried macroinvertebrates.

RESULTS

A total of 125 live specimens of small freshwater Bivalvia peaclams species belonging to the Sphaeriidae Family and to two different genera, were collected in many watersheds (Figure 1, tables 1 & 2) and preserved in ethanol 70°. Registered specimens were deposited both in public (EPHE, Perpignan, France) and private collections (HYDRECO, Kourou, French Guiana). The material collected included a total of 81 *Pisidium punctiferum* (Guppy, 1867) and 44 *Eupera viridans* (Prime, 1865).

Identifications of the species were made according to specific conchologically characters (Kuiper, 1983) and original descriptions of Guppy (1867) for *P. punctiferum* and Prime (1865) for *E. viridans*.

Diagnose of the striate peaclam *P. punctiferum* was established according to the following criteria: 1/ The average size when adult is around 3 mm in length and 2.5 mm in height; 2/ The shell is oval and thin, the anterior valve is shorter and angulated in its posterior part; 3/ The test is diaphanous, finely striate concentrically and covered with numerous granular points, which are finer and more crowded on the

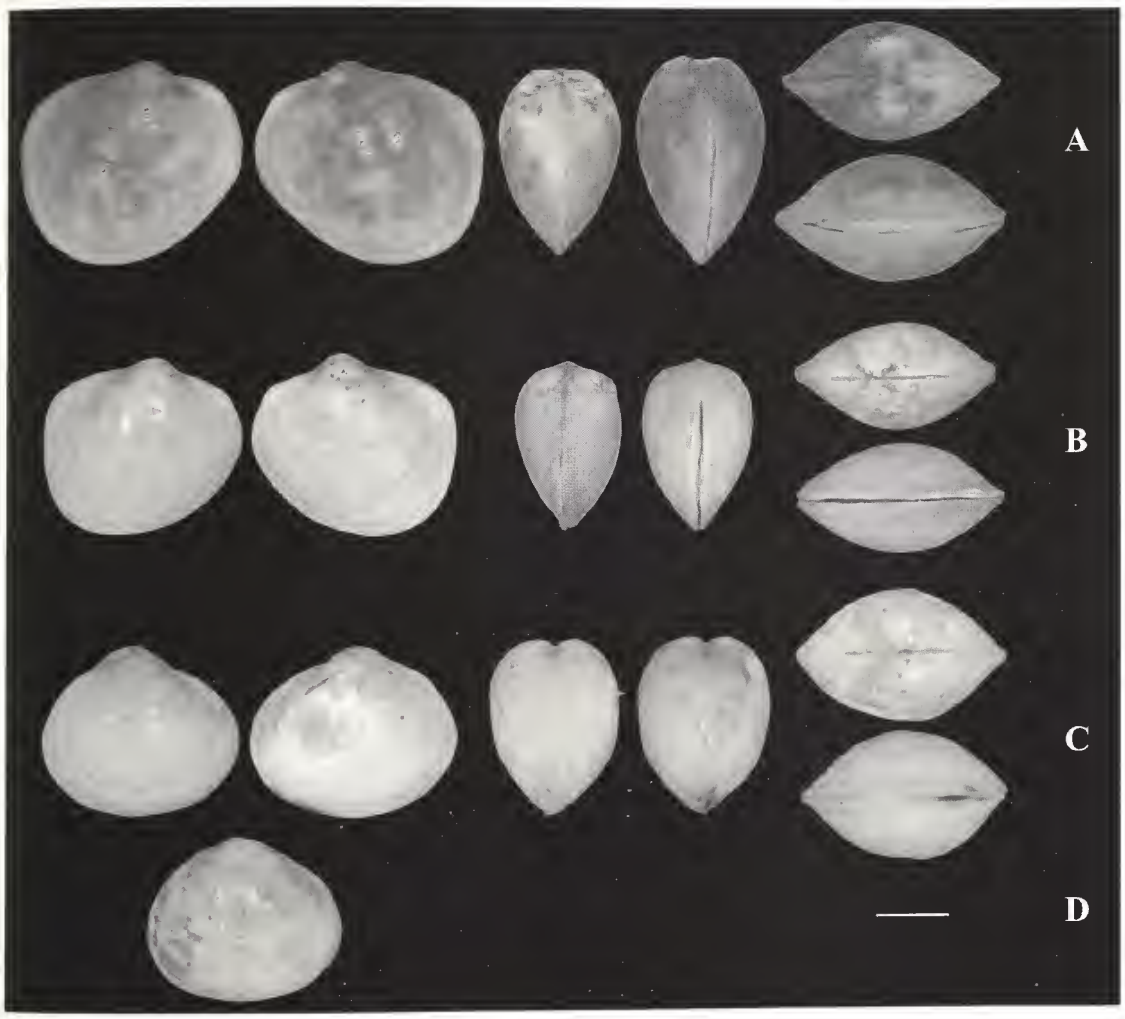

Figure 2. A. *Eupera viridans* (Prime, 1865), Crique Leblond, Sinnamary 4.1 mm; **B.** *Eupera viridans* Crique Leblond, Sinnamary 3.8 mm; **C.** *Pisidium punctiferum* (Guppy, 1867), Crique Arataï, Régina 2.9 mm; **C.** *Pisidium punctiferum* Saut Fracas 3.1 mm.

umbones, where the concentric striation is less evident; 4/ A short periostracum may be present and 5/ The hinge is well-developed with lateral teeth in both valves (1-1/1-1) and small cardinal teeth (2/2).

Diagnose of the mottled fingernail clam *Eupera viridans*, was established according to the following criteria: 1/ The size can be of about 8 mm when adult (Pointier, 2008); 2/ The shell is oblong, compressed and inequilateral, the anterior side is shorter and rounded, the posterior one is sub abrupt and the basal margin is slightly rounded; 3/ The test has very regular and delicate striation, a cream colour with irregular dark brown spots, 4/ There is no mention of periostracum and 5/ It presents a sub central umbo and a cardinal tooth on each valve (Pointier, 2008).

DISCUSSION

The small freshwater mussels belonging to the Sphaeriidae Family are distributed all over the world and the main genera, *Pisidium*, is cosmopolitan (Kuiper, 1983). *Pisidium punctiferum* was described from the Caribbean Island of Trinidad in 1867, under the name *Cyclas punctifera*; the type locality is a pond at Saint Ann's River, near Port of Spain (10°39'00" N / 61°31'01" W): specimens were collected by the government botanist Prestoe and by Guppy [*The first example was found by Mr. Prestoe, the colonial botanist, when we were examining the weeds in a pond at St. Ann, near Port of Spain, for Mollusca*].

Authors took a special care to compare the collected specimens to the peaclam *Pisidium sterkianum* Pilsbry, 1897 because this species is widely distributed from the Guiana Shield [from Venezuela (specimens collected by one of us, JPP, in 1987 and identified by Kuiper) and Brazil (Agudo-Padrón, 2009; Mansur & Pereira, 2006)] to Argentina (Darrigran & Pastorino, 1995; Ituarte, 2007), including the Peruvian Amazon (Ituarte, 2004), Paraguay and Uruguay (Scarabino & Mansur, 2007). *Pisidium sterkianum* occupies the same type of

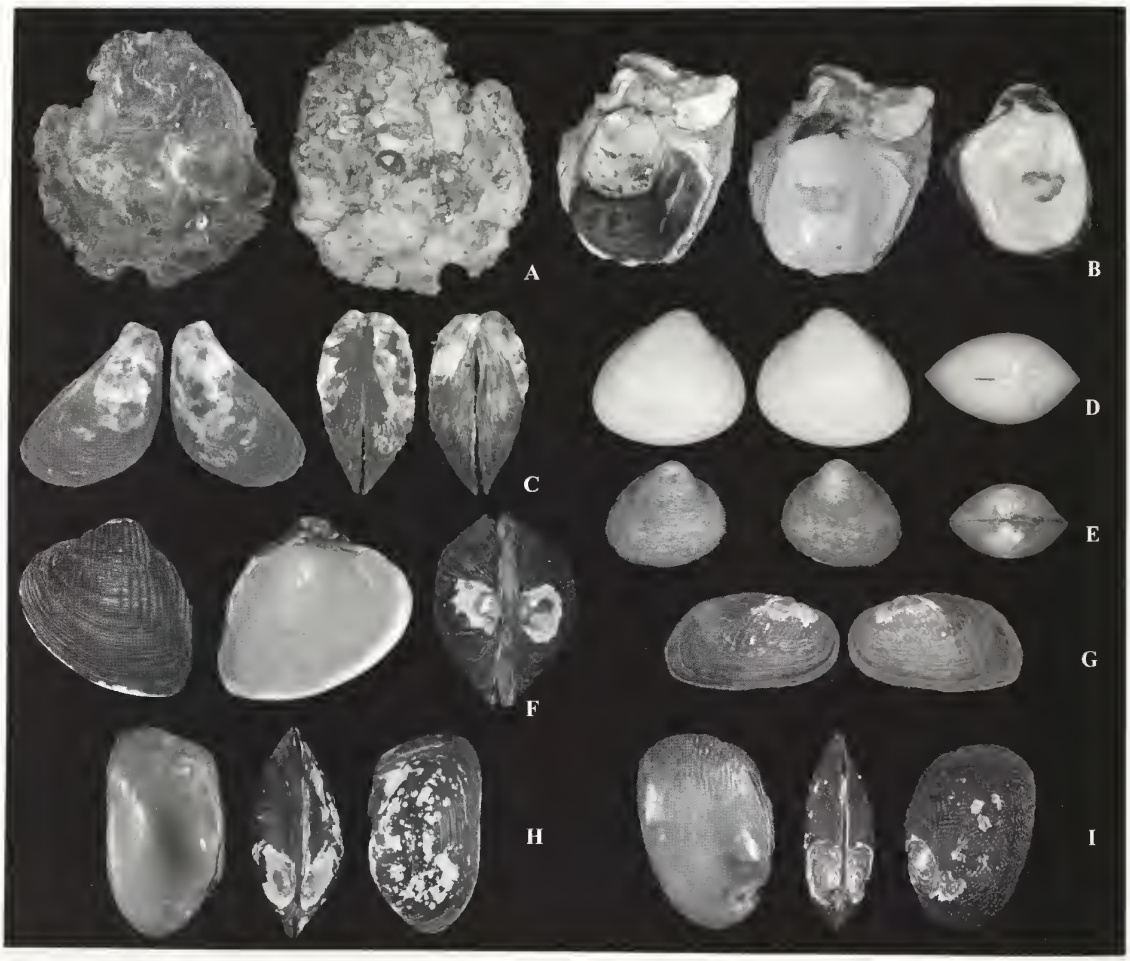

Figure 3. A. Ostreidae *Crassostrea rhizophorae* (Guilding, 1828), specimen collected on rocks, Montsinéry French Guiana, 93 mm; **B.** Ostreidae *Crassostrea rhizophorae* (Guilding, 1828), specimen collected on a root in a mangrove, Montsinéry French Guiana, 78 mm; **C.** Dreissenidae *Mytilopsis leucophaeata* (Conrad, 1831), Montsinéry French Guiana, 20 mm; **D.** Corbiculidae *Polymesoda* cf. *aequilatera* (Deshayes, 1855), specimen without periostracum, Montsinéry French Guyana, 24 mm; **E.** Corbiculidae *Polymesoda* cf. *aequilatera* (Deshayes, 1855), specimen with periostracum, Montsinéry French Guyana, 17 mm; **F.** Hyriidae *Castalia sulcata* (Krauss, 1849), Tampok French Guiana, 47 mm; **G.** Hyriidae *Diplodon granosus* (Bruguière, 1792), French Guiana, 19 mm; H: Hyriidae *Diplodon voltzi* Vernhout, 1914, MNHN, Litany French Guiana, 64 mm; **H.** Hyriidae *Diplodon granosus* (Bruguière, 1792), Holotype MNHN, Cayenne French Guiana, 38 mm.

habitats than *P. punctiferum*, i.e. small streams, lakes, etc. Consequently, *P. sterkianum* could probably be present in the study area. This species may be distinguished from *P. punctiferum* according to the following characters (Pilsbry, 1897): 1. The average size when adult is around 6 mm in length and 5 mm in height; 2. The shell is equilateral with the anterior end broadly truncated and beaks full but rather small; 3. The test, glossy, light yellowish outside and greyish-white inside, is very finely striated concentrically without granular points; 4. There is no mention in literature on the presence of periostracum and 5/ The cardinal teeth are parallel and the lateral tooth is lower and longer in the left valve.

Pisidium punctiferum is mentioned in literature (Figure 4) from the United States of America [Kentucky, Virginia, Illinois, Texas and northeast Florida (Heard, 1979; Turgeon et al., 1998)] to southern Brazil [Rio Grande do Sul State (Agudo-Padrón, 2009; Martello et al., 2006; Simone, 2006)] and Uruguay (Henry, 1897), including the West Indies [Dominica (Starmühlner, 1988), Guadeloupe (Pointier 1974; 1976; 2008), Martinique (Guyard & Pointier, 1979; Pointier 2008), Saint-Lucia (Jordan, 1985 ; Mc Killop & Harrison, 1981; 1982) and Saint-Vincent (Harrison & Rankin, 1978)].

The species is mentioned in literature as living in Cuba (Starmühlner, 1988). It is probably due to misidentification, because even after recent investigations it has not been found there (Pointier et al., 2005). It is also signalled by the same author as

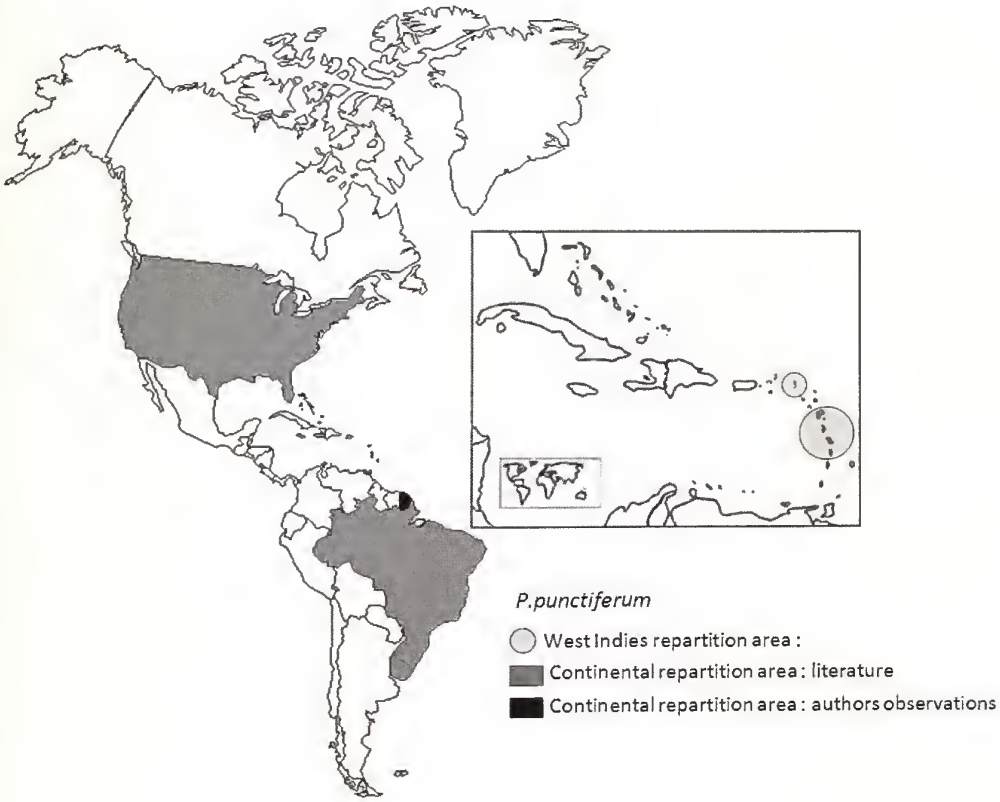

Figure 4. Distribution area of *Pisidium punctiferum*.

inhabiting Mexico, Panama, Jamaica, Venezuela and Paraguay but without any precise mention nor author.

The present discovery expands the distribution of *P. punctiferum* to French Guiana and, consequently, to the Guiana Shield. Otherwise, the presence in neighbouring Suriname, where the species is not yet mentioned, is highly probable because 20 specimens were found in the Maroni River, frontier between Suriname to the west and French Guiana to the east [Apsik Icholi (05°09'06" N / 54°20'21" W), Crique Apatou (03°48'20" N / 54°08'36" W) and Papaïchton (3°05'34" N / 52°20'28" W)]. So, if the species has already been recorded in southern Brazil, its distribution area is potentially also extended to the northeast Brazil, because one piece was collected in the Oyapock River, frontier between French Guiana to the west and the Amapa State to the east.

In literature, most authors mentioned to have observed *P. punctiferum* in lentic habitat: on the Saint Vincent Island, Harrison & Rankin (1978) found the maximum population densities in swamps; In Dominica, it was observed in exposed sunlit ponds (Starmühlner, 1988); In Guadeloupe, the species is inhabiting swamps, canals and flooded meadows (Pointier, 1974, 1976). In French Guiana, *P. punctiferum* has a large distribution area all over the territory, from east to west, near the coastal line [Crique Apatou (03°48'20" N / 54°08'36" W) and Crique Eau Claire (05°08'45" N / 52° 52'09" W)] to the head watershed [Apsik Icholi (02°59'10" N / 54°10'53" W)]. The species has a large ecological plasticity because it occupies a numerous variety of habitats as it was recorded from small streams with clear water (Crique Apatou and Crique Eau Claire) to muddy large rivers [Papaïchton (3°05'34" N / 52°20'28" W)]. The site where the most important number of specimens was collected (33) is a natural rocky riffle environment without significant entropic pressures, [Saut Dalles, Sinnamary Watershed (04°33'21" N / 52°54'03" W)]. A single individual was also found into the reservoir lake of Petit-Saut [Vata (04°51'58" N / 52°57'41" W)]. The species was mainly found in water without entropic pressure. It would be interesting to focus on the sampling effort in these habitats in the rainy season, when the freshwater level grows, creating a lot of standing water habitats.

Eupera viridans was described from the Caribbean Island of Guadeloupe in 1865, under the name of *Sphaerium viridante* by Prime (1865). The type locality is the city of Pointe-à-Pitre (16°14'00" N / 61°31'00" W). Little is known about its natural distribution (Figure 5). The species is only mentioned in literature from the West-Indian Islands of Guadeloupe (Pointier, 2008), Martinique (Delannoye, *personal communication*, 2010), Saint-Lucia (Pointier, 2001) and Saint-Martin (Coonans, 1967). *Eupera cubensis* (Prime, 1865) is probably a synonym of *E. viridans*. Consequently, the distribution of the species

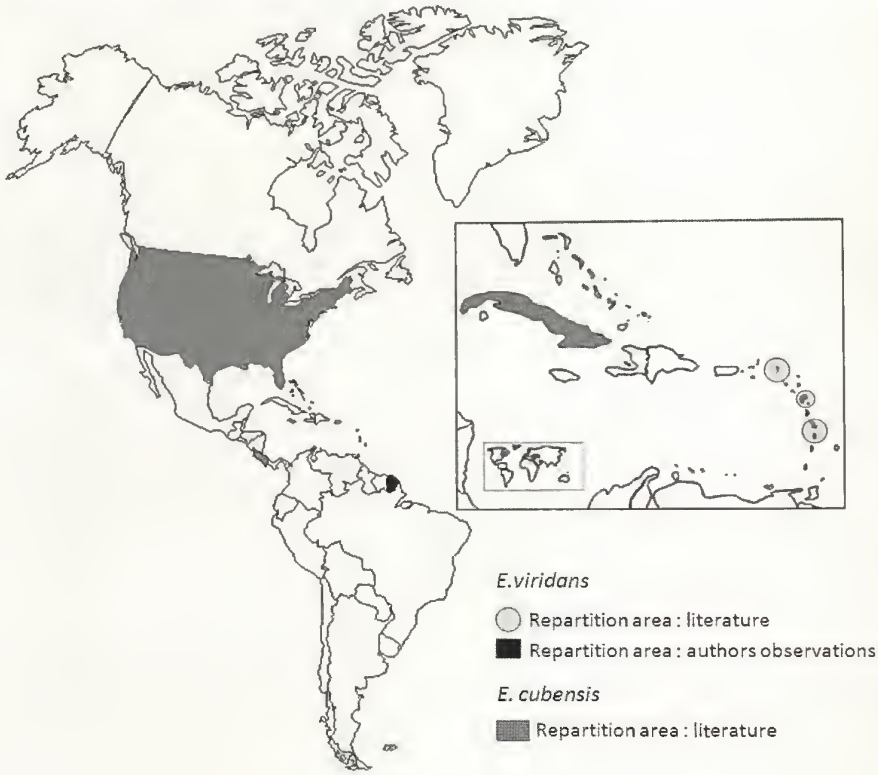

Figure 5. Distribution area of *Eupera viridans*.

could be enlarged to Cuba, Costa Rica (Volkmer-Ribeiro & Machado, 2009), Texas and Florida (Heard, 1979) and to the Upper Mississippi River Basin too (Illinois), but as an introduced species (Sneen et al., 2009). The discovery of *E. viridans* in French Guiana would be the first record of this species for the South American continent. However, this information must be taken with caution, because the systematic of this genus remains confusing and misidentifications may occur in the literature.

In the Lesser Antilles, *Eupera viridans* is common in marshes, canals and ponds, attached to the aquatic vegetation or to wood debris (Pointier, 2008). In French Guiana, the 44 observed specimens were collected in a single spot at Leblond [Sinnamary watershed (04°46'37" N / 53°07'08" W)], an altered stream under entropic pressures such as illegal gold-mining or domestic sewages (Comité de Bassin de Guyane, 2006); this Bivalvia appears like a not sensitive taxa in terms of bio indication. Punctually distributed and first mentioned on the South America continent, the species has a patrimonial value for French Guiana.

In conclusion, we have to mention that the detection of minute clams is difficult in the coloured and charged in wood debris of the Guiana freshwaters. Lack of studies on this group together with these characteristics i.e. small size, difficult visual detection, explains the late discovery of relatively abundant taxa on this territory. Sampling method is also an explanatory factor. Without a standardized collect protocol, knowledge on freshwater molluscs remains uncompleted (Massemin et al., 2009). The use of a hand net with very small mesh size (200 µm) would be a good alternative to collect minute species. In 2010, three new species of freshwater molluscs (one Gastropoda and two Bivalvia) from French Guiana were found using this technique, increasing the number of freshwater species mentioned from this overseas department. Why couldn't the discovery of other species be expected in the future?

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Study site	Watershed	Habitat type	GPS	Number of specimens
Crique Eau Claire	Kourou	little stream	05°08'45" N / 52° 52'09" W	1
Takari Tanté	Sinnamary	large river	04°37'18" N / 52°55'38" W	2
Vata	Sinnamary	reservoir lake	04°51'58" N / 52°57'41" W	1
Saut Fracas	Mana	large river	04°45'30" N / 53°40'49" W	4
Arataï	Approuague	large river	04°01'36" N / 52°41'35" W	17
Saut Dalles	Sinnamary	large river	04°33'21" N / 52°54'03" W	33
Athanase	Approuague	large river	04°10'50" N / 52°21'14" W	2
Apsik Icholi	Maroni	large river	02°59'10" N / 54°10'53" W	5
Crique Apatou	Maroni	little stream	05°09'06" N / 54°20'21" W	2
Papaïchton	Maroni	large river	03°48'20" N / 54° 08'36" W	13
Para Itou	Oyapock	large river	03°05'34" N / 52°20'28" W	1
Total				**81**

Table 1

Study site	Watershed	Habitat type	GPS	Number of specimens
Leblond	Sinnamary	mid-order stream	04°46'37" N / 53°07'08" W	44
Total				**44**

Table 2

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Appendix 1

In French Guiana, Bivalvia of brackish waters, as oysters, can be observed up to more than 50km inside lands and are therefore considered by the authors to be continental species; size is expressed for adult shells. Drawing by the authors (DM).

1	**1.1**	Hinge dysodont (absence of tooth)	**2**
	1.2	Hinge heterodont (cardinal and lateral teeth presents and dissimilar)	**3**
2	**2.1**	Shell extended, widened and rounded behind, end not sharp (mytiliform); internal surface entirely pearly; in brackish water; shell attached by a byssus to hard substratum size of 10 to 20 mm	Dreissenidae *Mytilopsis leucophaeata* (Fig. 1)
	2.2	Shell oval to variable-shaped, kept closely; internal surface entirely pearly; in brackish water size more than 9 mm	Ostreidae *Crassostrea rhizophorae* (Fig. 2)
3	**3.1**	Shell circular to suboval; in freshwater; size less than 8mm	**4** (Sphaeriidae)
	3.2	Shell rectangular to subtrigonal; in freshwater; size up to 40 mm	**5** (Hyriidae)
	3.3	Shell subtriangular clam-shaped; in brackish water; size up to 10mm	**7** (Corbiculidae)
4	**4.1**	The umbo is central	**8** (*Pisidium*)
	4.2	The umbo is subcentral	**9** (*Eupera*)
5	**5.1**	Shell subtrigonal; cardinal teeth well developed; test concentrically sculptured; size up to 45 mm	*Castalia sulcata* (Fig. 3)
	5.2	Shell rectangular; cardinal teeth not well developed	**6**
6	**6.1**	Tessellata sculpture; muscle scar rounded at the posterior end; size up to 40mm	*Diplodon granosus* (Fig. 4)
	6.2	Concentric sculpture; muscle scar angulated at the posterior end; size up to 60mm	*Diplodon voltzi* (fig.5)
7		Pallial sinus well developed; size more than 20 mm	*Polymesoda aequilatera* (Fig. 6)
8	**8.1**	Shell oval and compressed; test matt and diaphanous; whitish, slightly tinted with fuscous patches; surface finely concentrically striated and covered with granular points; lateral teeth similar in both valves; minute species (3-5mm)	*Pisidium punctiferum* (Fig. 7)
	8.2	Shell inequilateral and rounded;	

test glossy light yellowish;
surface very finely concentrically striated and uncovered with granular points;
lateral teeth lower and shorter in left valve;
size from 6 to 8 mm _____ *Pisidium sterkianum*
(Species probably present)

9 The test is cream colour ornamented with dark brown sports;
one cardinal tooth on each valve;
size of about 8 mm _____ *Eupera viridans* (Fig. 8)

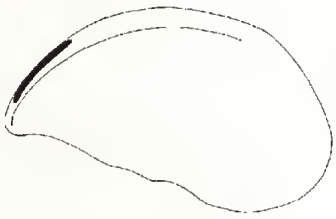
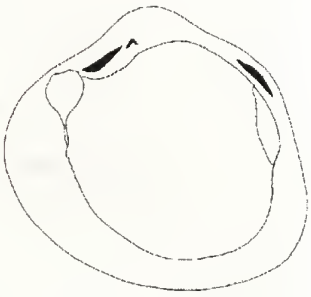


Fig. 1

Fig. 2



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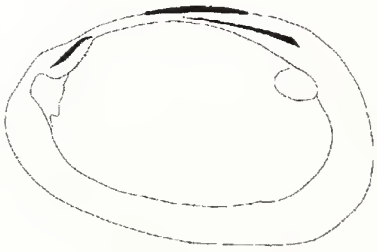

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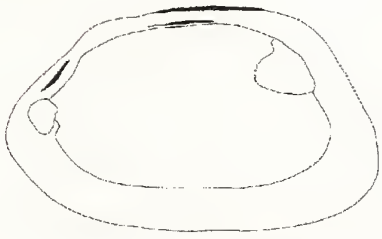

Fig. 5

Fig. 6

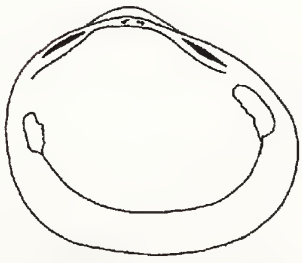

Fig. 7

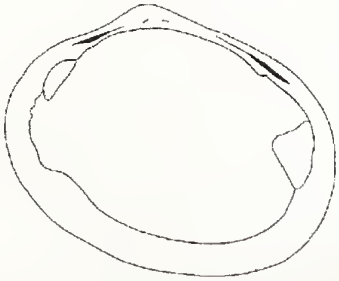

Fig. 8

New Lyriinae (Mollusca: Volutidae) from the Lower Miocene Cantaure Formation of Venezuela

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ABSTRACT. The subfamily Lyriinae (Volutidae) is recorded from the early Miocene Cantaure Formation of Venezuela for the first time. Two species are recorded: *Lyria gabbi* Vokes, 1998, which is also found in the Lower Miocene Baitoa Formation of the Dominican Republic, and *Enaeta inornata* n. sp.

KEYWORDS. Lyriinae, Mollusca, *Lyria, Enaeta*, Miocene, Cantaure Formation, Venezuela, new record, new species

INTRODUCTION

No species of Lyriinae Pilsbry & Olsson, 1954 were mentioned in Jung's (1965) systematic description of the Lower Miocene Cantaure Formation fossil molluscan assemblage on the Paraguaná Peninsula, Venezuela. This is hardly surprising, as both the species recorded here are extremely rare in these deposits. We discuss one new record of *Lyria* Gray, 1847 and describe a new species of *Enaeta* Adams & Adams, 1853 from the Cantaure Formation.

Material and Methods

The material described here is from the Gibson-Smith collection housed in the Naturhistorisches Museum Basel (NMB coll.), Switzerland and the Bernard Landau collection (BL coll.), now deposited in the Naturhistorisches Museum Wien (NHMW coll.), Vienna. We have examined other collections from this locality, and none contains any species of Lyriinae.

SYSTEMATIC PALAEONTOLOGY

CLASS GASTROPODA
SUPERFAMILY **VOLUTOIDEA** Rafinesque, 1815
Family **VOLUTIDAE** Rafinesque, 1815
Subfamily **LYRIINAE** Pilsbry & Olsson, 1954
Genus ***Lyria*** Gray, 1847

Type species (by original designation): *Voluta nucleus* Lamarck, 1811.

Lyria gabbi Vokes, 1998
Figs 1, 2

Lyria pulchella (Sowerby). Gabb 1873, p. 219 (in part; non G. B. Sowerby I, 1850).
Lyria soror (Sowerby). Pilsbry 1922, p. 338, pl. 24, figs 11-12 (non G. B. Sowerby I, 1850).
Lyria (Lyria) gabbi E. H. Vokes 1998, p. 11, pl. 1, figs 7-8.

Material and dimensions. Two specimens; larger, NHMW 2009z0079/0006 (ex BL coll.), height 33.7 mm; lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón, Venezuela (= locality GS12PGNA of Gibson-Smith & Gibson-Smith 1979) (1 other in BL coll.).

Discussion. *Lyria gabbi* Vokes, 1998 was originally described from the coeval Baitoa Formation of the northern Dominican Republic. Vokes (1998) singled out the presence of sharp barbs (prolongations of denticles present within the outer lip) along the margin of the outer lip as the most characteristic feature of this species. Neither of the shells from Cantaure are perfectly preserved; both have the apex missing and the barbs on the outer lip are worn, but the denticles within the outer lip are clearly visible (Fig.1), and in a similar position to those seen in a specimen of *Lyria gabbi* from the type locality (Fig. 3). Vokes (1998) discussed the presence of a very faint colour pattern on the Dominican shells, consisting of fine spiral lines about 1 mm apart. A similar pattern can be seen on the Cantaure specimens (Fig.1). The position and character of the axial ornament and denticles on the columellar lip are also identical. *Lyria limata* Hoerle & Vokes, 1978 (Figs 5-6) from the contemporaneous Chipola Formation of NW Florida also has these barbs on the outer lip, but is otherwise not especially similar, with fewer, broader axial ribs and a taller spire.

Later Tropical American *Lyria* species seem to have lost the barbs on the edge of the outer lip. *Lyria*

pulchella (Sowerby, 1850) (Figs 7-8) from the Upper Miocene Cercado, Lower Pliocene Gurabo and Mao formations of the Dominican Republic has quite a different shell shape, with a far more inflated last whorl, less numerous, broader ribs and a thickened, abapically flared outer lip. This is also the only common *Lyria* species in the tropical American deposits. *Lyria incomperta* Hoerle & Vokes, 1978 (Figs 9-10), also from the Cercado and Gurabo Formations of the Dominican Republic, but almost totally confined to coralline facies (Vokes 1998), has finer axial sculpture more similar to that of *L. gabbi*, but has a proportionately higher spire. Both *L. pulchella* and *L. incomperta* have smooth outer lips, without the barbs seen in *L. gabbi*. For further comparisons see Vokes (1998).

To our knowledge, the two early Miocene *Lyria* species with barbed outer lips are the only tropical American gastropods with this character. In the Recent fauna, barbed lips are confined to the Indo-West Pacific, or to species that have only very recently colonized the eastern Pacific (e.g. *Casmaria vibexmexicana* Stearns, 1894). Barbed lips occur in the strombid genus *Tridentarius* (Kronenberg & Vermeij 2002), the cassid genera *Casmaria* and *Phalium* (see Beu 2008), the mitrid genus *Mitra* (sensu stricto) (Cernohorsky 1976), some species of *Harpa* (see Rehder 1973), and in several nassariids including the genus *Alectrion* (Cernohorsky 1984). The function of these barbs remains unclear, but defence is a distinct possibility, especially in those cassids, strombids, and nassariids in which some of the barbs point anteriorly.

From a paleobiogeographical point of view, the Dominican deposits belong in the West Indian Subprovince, whereas the Cautaure deposits are within the Columbian-Venezuelan-Trinidad Subprovince of the Neogene Gatunian Province (see Woodring 1974; Vermeij & Petuch 1986; Landau et al. 2008). We can add *L. gabbi* to the relatively short list of species that occur in both of these paleobiogeographical subprovinces, together with the following species of *Enaeta*, and *Vasum tuberculatum* Gabb, 1873 (Vokes, 1998) and *V. haitense* (G. B. Sowerby I, 1850) (BL coll.).

Genus ***Enaeta*** H. Adams & A. Adams, 1853
Type species (by subsequent designation, Cossmann 1899): *Voluta harpa* Barnes, 1824 (junior primary homonym of *V. harpa* Mawe, 1823) = *Voluta barnesii* Gray, 1825.

Enaeta inornata n. sp.
Figs 11-16

Type material and dimensions. Holotype NMB H18371, height 30.8 mm, width 15.9 mm (Figs 11-13); paratype 1 NHMW 2009z0078/0001, height 25.0 mm, width 13.2 mm (Figs 14-16); paratype 2 NHMW 2009z0078/0002, height 29.9 mm, width 15.8 mm.

Type locality. Cantaure Formation (early Miocene: Burdigalian), Lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón, Venezuela (= locality GS12PGNA of Gibson-Smith & Gibson-Smith 1979).

Diagnosis. An *Enaeta* species with a medium-sized, solid, biconic shell, inflated last whorl and subdued sculpture consisting of weak spiral threads on the spire and six to eight axial ribs, developed only on the mid-portion of the last whorl.

Description. Shell medium-sized for genus, solid, biconic, with inflated last whorl. Protoconch missing. Teleoconch of five whorls with superficial linear suture. Spire short, conical, with periphery at abapical suture. Sculpture on spire of very faint spiral threads, visible only under magnification. Last whorl large, approximately 80% of total height, convex, weakly constricted at base, bearing six to eight relatively broad axial ribs developed only on mid-portion of whorl. Aperture elongate, approximately 55% of total height. Outer lip weakly convex, slightly flared abapically, thickened by labral varix, smooth within, except for one heavy denticle about two-thirds of distance from anterior end to posterior end of lip. Anal canal very narrow, shallow; siphonal canal short, open, narrow, posteriorly recurved. Parietal callus weakly developed immediately adjacent to anal canal, a thin callus wash below; columellar callus very slightly thickened. Columella bearing four strong oblique folds on abapical portion. Siphonal fasciole flattened, separated from base by small ridge of shell.

Discussion. Hoerle & Vokes (1978) and Vokes (1998) considered *Enaeta* to be a subgenus of *Lyria*. However, we follow Poppe & Goto (1992) and Bail & Poppe (2002) and consider the differences between the two sufficiently important to separate them at generic level within the Lyriinae (for discussion on radular characteristics of the group and taxonomic position see Poppe & Goto 1992, p. 19).

Two well-defined *Enaeta* species groups are present in Tropical American Recent and Neogene assemblages. The first is represented in the fossils assemblages by *Enaeta perturbatrix* (Maury, 1917) from the Lower Pliocene Gurabo Formation of the Dominican Republic. It is characterized by an elongate fusiform shell with a high spire and sculpture of numerous, well-developed axial ribs, although they are only well-developed at the periphery on the last whorl. This species is an early representative of the Caribbean group including *E. guildingi* (G. B. Sowerby I, 1844), *E. reevei* Dall, 1907 and *E. leonardhilli* Petuch, 1988 (probably a synonym of *E. guildingi*; Poppe & Goto 1992), which all have the same elongate fusiform shell shape and differ in details of their sculpture. All these species seem to have two stronger anterior folds on the columella and several weaker ones above. *Enaeta trechmanni* Jung,

1971 from the early Middle Miocene Grand Bay Formation (Robinson & Jung 1972; Donovan et al. 2003) probably also belongs in this group. Therefore, this group is recorded earliest in the Atlantic.

The second group also has fusiform shells, although stockier and more solid, with stronger axial sculpture that forms nodules at the shoulder. This is represented in the Recent Caribbean fauna by *Enaeta cylleniformis* (G. B. Sowerby I, 1844) and in the Recent tropical eastern Pacific fauna by *E. cumingii* (Broderip, 1832). According to Pitt & Pitt (1995), the predecessor of *E. cumingii* is *E. propecumingii* Pitt & Pitt, 1995 from the Upper Miocene Esmeraldas Beds of Ecuador. All these species have three strong abapical folds on the columella and a few weaker folds above. Therefore, this second group is recorded earliest in the Pacific.

Enaeta inornata n. sp. falls into a third group of less well-defined Tropical American species with more ovate shells, having a much larger last whorl and a proportionately shorter spire and rather discrete sculpture. Two fossil species bear some similarity to *E. inornata*: *E. isabellae* (Maury, 1910) [= *Strigatella americana* Dall, 1915, see Gardner 1937] from the Lower Miocene Chipola Formation of northwestern Florida (Figs 17-18) is the most similar in shape, height of spire and size of last whorl. It differs in the character of its ornament, which consists of narrow, weak, close-set axial ribs. *Enaeta ecnomia* Woodring, 1964 from the middle Middle Miocene Lower Gatun Formation of Panama is also similar to our Venezuelan species in shell shape, having a broad, solid last whorl, but is immediately distinguished by its sculpture consisting of about 18 axial ribs on the last whorl and close-set spiral threads covering the entire shell surface. *Enaeta ecnomia* and *E. isabellae* are more similar to each other than they are to *E. inornata*, but *E. ecnomia* has an even broader shell shape, a somewhat coeloconoid spire and fewer, slightly stronger axial ridges than *E. isabellae*. *Enaeta olssoni* Hoerle & Vokes, 1978 also from the Late Miocene middle-upper Gatun Formation of Cativa, Panama, and also known from a single individual, is similar to *E. isabellae*, but has no axial sculpture at all, moreover it has placations on the posterior portion of the columella.

In the Recent faunas there are no representatives of this group in the Caribbean, although *Enaeta barnesii* (Gray, 1825) from the Recent tropical eastern Pacific is similar in having almost no surface sculpture and an inflated last whorl, even more so than any of the fossil forms. All of these species, except *E. olssoni*, have four strongly developed folds on the columella. It is likely that *E. inornata* is more closely related to this Recent tropical eastern Pacific species than to the extant Caribbean forms. However, we stop short of calling them a paciphilic clade (sensu Vermeij & Petuch 1986) as this phylogeny is not indisputable.

From a paleobiogeographical angle, both *Lyria* and *Enaeta* were present in both the Gatunian and Caloosahatchian Paleobiogeographical provinces during the early Miocene, but subsequently suffered a range contraction so that by the late Miocene-early Pliocene they were only present in the more southern Gatunian Province (see Vermeij & Petuch 1986; Landau et al. 2008).

Etymology. The name reflects the very weak ornament.

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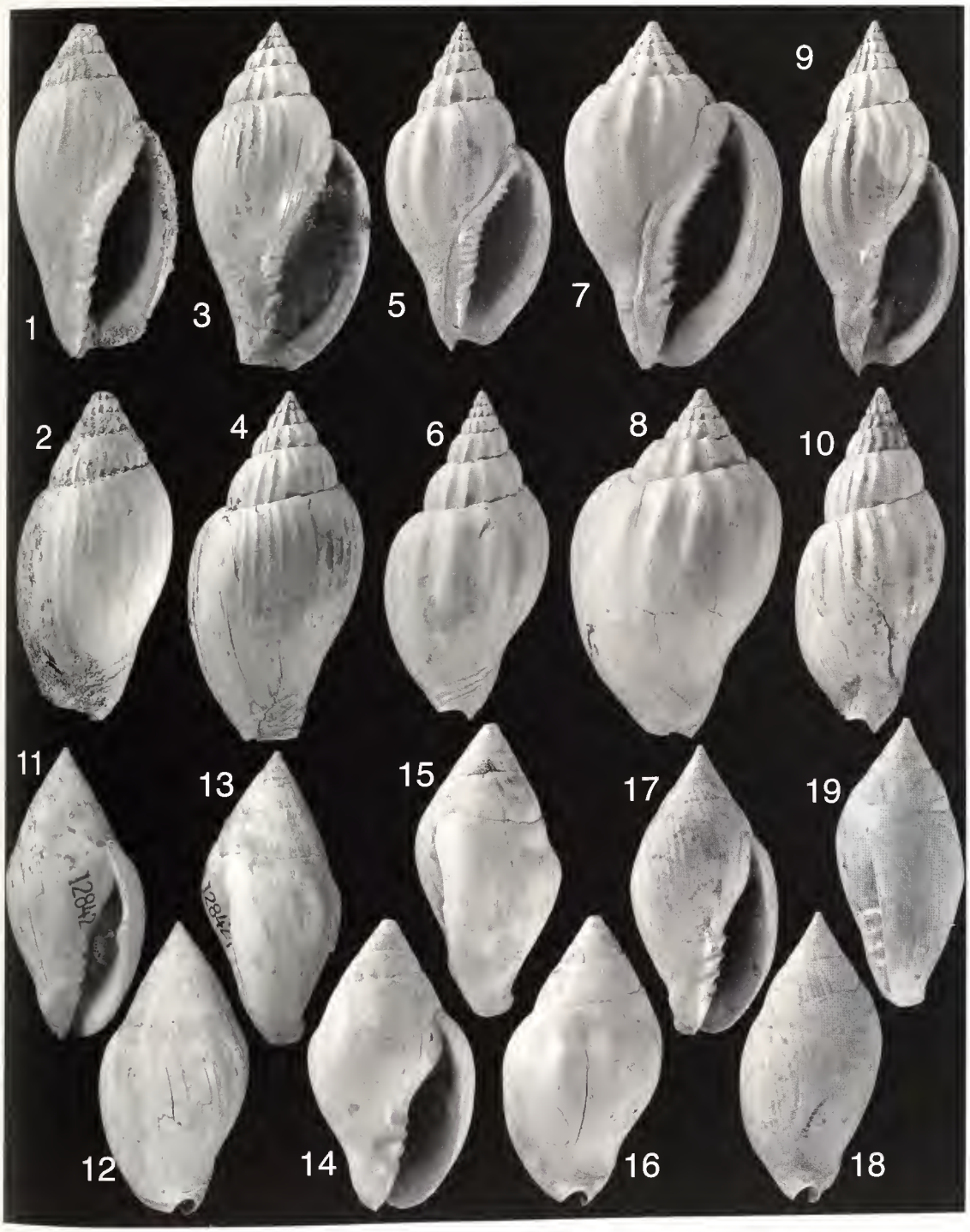
Figures 1-18

1-2. *Lyria gabbi* Vokes, 1998, NHMW 2009z0079/0006 (ex BL coll.), height 33.7 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **3-4.** *Lyria gabbi* Vokes, 1998, NHMW 2009z0079/0001 (ex BL coll.), height 44.3 mm, Baitoa Formation (early Miocene: Burdigalian), E side Rio Yaqué del Norte, just above mouth of Arroyo Hondo, Dominican Republic (= NMB 17290; see Saunders et al. 1986). **5-6.** *Lyria limata* Hoerle & Vokes, 1978, NHMW 2009z0079/0002 (ex BL coll.), height 33.1 mm, Chipola Formation (early Miocene: Burdigalian), Tenmile Creek, 2.8 km W of Chipola River, Calhoun County, Florida (= TU 546; see Hoerle & Vokes 1978). **7-8.** *Lyria pulchella* (Sowerby, 1850), NHMW 2009z0079/0003 (ex BL coll.), height 28.8 mm, Gurabo Formation (early Pliocene: Zanclean), Gurabo River, E bank, first bluff downstream from ford on Los Quemados-Sabaneta road, Dominican Republic (= TU 1210; see Saunders et al. 1986). **9-10.** *Lyria incomperta* Hoerle & Vokes, 1978, NHMW 2009z0079/0004 (ex BL coll.), height 47.0 mm, Cercado Formation (late Miocene: Tortonian), unnamed formation, López area, Rio Yaqué del Norte, Dominican Republic (= NMB 17273; see Saunders et al. 1986). **11-13.** *Enaeta inornata* n. sp., holotype, NMB H18371, height 30.8 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **14-16.** *inornata* n. sp., paratype, NHMW 2009z0078/0001 (ex BL coll.), height 25.0 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **17-18.** *Enaeta isabellae* (Maury, 1910), NHMW 2009z0079/0005 (ex BL coll.), height 33.1 mm, Chipola Formation (early Miocene: Burdigalian), Tenmile Creek, 2.8 km W of Chipola River, Calhoun County, Florida (= TU 546; see Hoerle & Vokes 1978).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NOTE AUX AUTEURS

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Les numéros hors série sont publiés irrégulièrement. Les auteurs désireux de soumettre un article pour un numéro hors série (40 pages imprimées ou plus) sont priés de contacter auparavant la Société Belge de Malacologie à l'adresse ci-dessous.
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Les auteurs devront suivre strictement les règles du *Code de Nomenclature Zoologique* (quatrième édition).
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Powell, A.W.B. 1979. *New Zealand Mollusca. Marine, land and freshwater shells*. William Collins Publishers Ltd: xiv + 500 pp.
Mayr, E. 1989. Attaching names to objects. In: *What the philosophy of biology is : essays for David Hull* (M. Ruse, ed.), Klumer Academic, Dordrecht: 235-243.
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